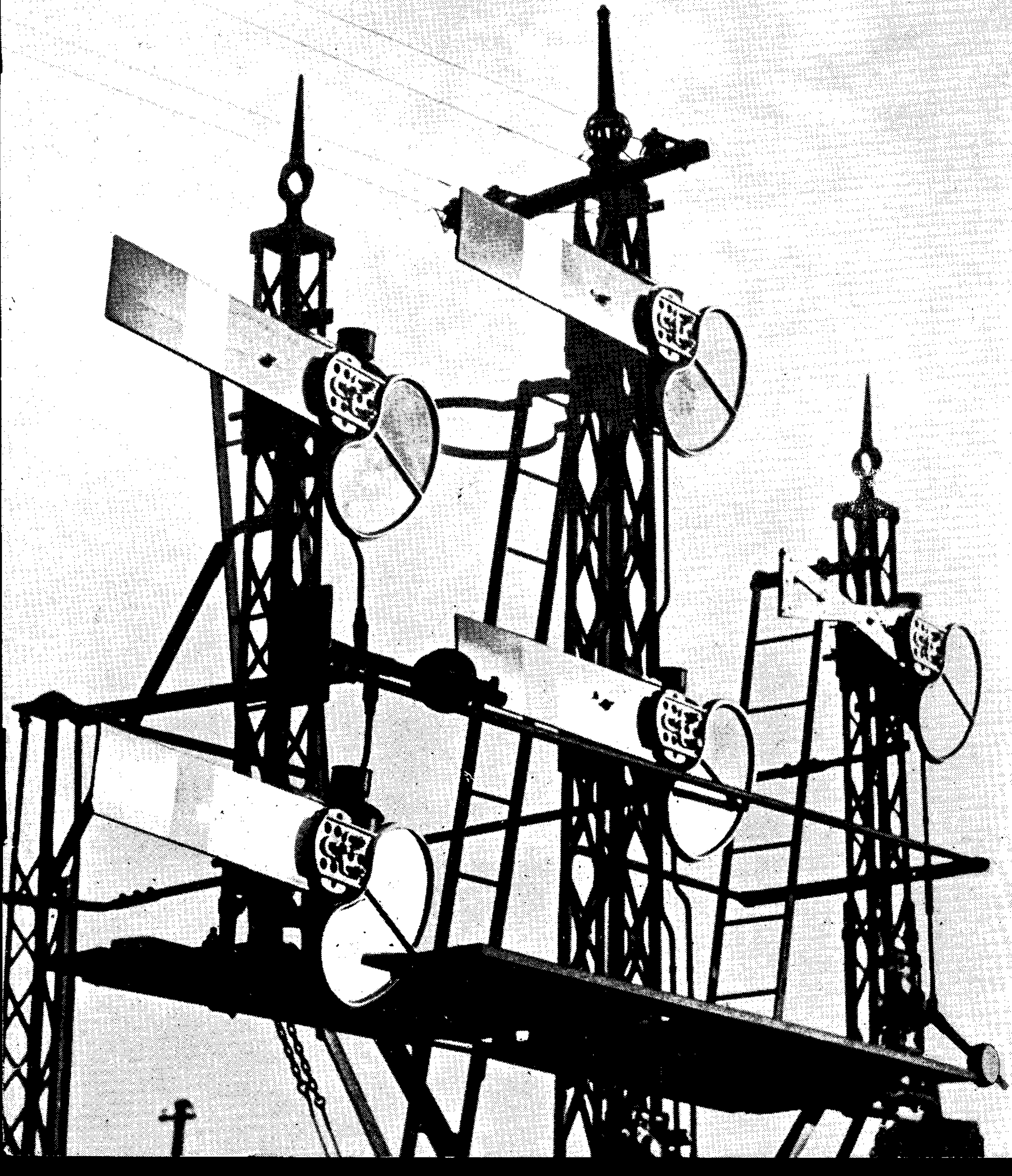
THE MODEL ENGINEER

Vol. 96 No. 2402 THURSDAY JUNE 5 1947 9d



The MODEL ENGINEER

Percival Marshall & Co. Ltd., 23, Great Queen St., London, W.C.2

5 JUNE 1947

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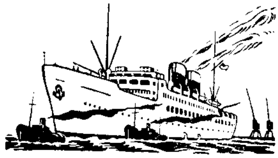

SMOKE RINGS

Our Cover Picture

TO many railway enthusiasts, the old semaphore signals—for so long, and in such great variety—were always fascinating. Our cover picture this week is from a photograph taken by Mr. O. Marcus, of Edinburgh, and shows a gantry of signals at Perth. The arms are of the old Caledonian Railway pattern. Incidentally, one of the features of C.R. signals was the provision made for adjusting the position of the spectacle-frame longitudinally, clearly visible in the picture.

Wanted—A Passenger Track

A NOTE from Mr. R. A. Smith, the Hon. Secretary of the Perranporth Society, tells me that they have an exhibition in prospect to be held at St. Michaels Church Hall from July 24th to 26th. They are desirous of having a passenger track in operation, but have not yet reached the affluent stage of possessing their own track. Is there any West Country society or private owner who would be kind enough to lend, and if possible operate such a track for the three days in question? The Perranporth members would be very grateful for such co-operation, and, as some modest return, would be willing to accommodate one or two helpers as guests for the period. Space for a run of 60 to 70 ft. of track could be provided, and an engine or two would be additionally welcome. Offers should be addressed to Mr. R. A. Smith, c/o Mr. A. A. V. Westcott, St. Piran's Road, Perranporth. Loan models for the exhibition would also be appreciated.

Exhibition Entries

I HOPE that intending entrants in the Competition Section of our Exhibition will not unduly delay the return of their entry forms. We want to display the models as effectively as possible this year, and, at the moment, it looks as though space is going to be at a premium. Practically all the space available for trade stands has been booked, and we are now giving our close attention to the best method of showing the competition models to advantage. If there is a rush of entries at the last minute we may have to close the acceptance list at an earlier date than contemplated. We should especially like societies who have their eye on the handsome Club Cup to send their nominations in good time to ensure the effective display of their members' work. This is the first year in which there is a Club Championship to be awarded; I hope this distinction will be worthily competed for and worthily won.

Model Engineers on Tour

MR. K. J. EASTON writes :—

"I was most interested to read in 'Smoke Rings' in the issue for May 15th of the two Post Office officials who contacted members of the North Staffordshire Society—I was one of them! The other was Mr. C. H. Taylor, a member of the S.M.E. I am myself a member of the Harrow Model Railway Society, and the Gauge '1' Model Railway Association, being on the committees of both those bodies. Our duties

take us to various parts of the country, and in the course of our travels we make it a habit, whenever possible, to contact model engineering societies in the localities we visit. In this way evenings away from home which can so easily be tedious become hours of profit and enjoyment for ourselves, and, we hope, for those with whom we come into contact. We feel that we are doing something towards bringing closer together all those who, though they may live far apart and belong to different societies, have one absorbing interest in common. During the trip referred to by Mr. Lockett we also spent enjoyable evenings with Messrs. Dunkley and Owen, of the Coventry Society, attended a meeting of the Sale Society, and were entertained by their secretary, Mr. Williams, and met several lone hands in Northampton, Stockport and Chester. I have also met members of the Salisbury and Exeter clubs, and through the latter met Major Sparkes, whose excellent drawings of G.W.R. vehicles I have often used over the last fifteen years, and with whom I have since spent several very interesting evenings. I should like, through you, to send my greetings and sincere thanks to all the friends we have met, and to suggest to others of your readers whose duties take them away from home that if they cared to follow our example they would be delighted at the welcomes they would find, and would at the same time be strengthening the bonds of interest and friendship between societies and between model engineers as a whole. I would add that any model engineer visiting London would be very welcome either at my home or any Friday evening at meetings of the Harrow Model Railway Society. My address is 91, The Avenue, Wembley Park, Middlesex."

Waterline Models

WE publish herewith an interesting photograph of a group of water-line models made recently by Mr. W. R. Finch, of Potters Bar. The warships will be easily recognised as the battleship H.M.S. *King George V*, and the battle-cruiser H.M.S. *Hood*. The tanker is the *Comanchee*, which belongs to the Anglo American Oil Co. The models are built to the scale of 50 ft. to 1 in., and the amount of detail included, much of which I fear will be lost in the reproduction, is highly creditable to the builder. The comparison between the fullness of the lines of the tanker and the fineness of those of the warships, especially in the case of the *King George V*, where the fineness is combined with tremendous beam, is both interesting and instructive. The tanker is shown in its post-war colours which, in the photograph, tends to obscure the fine detail work. The builder made his own designs for the warships, basing them on numerous photographs, and the information contained in "Jane's Fighting Ships." The tanker was built from authentic drawings published in the *Shilbuilding and Shipping Record*, some years ago. The models were built in the usual manner, with wood for the hulls and basic superstructure, card or cartridge paper for the smaller details and for the funnels and metal where metal was specially applicable. The two warship models are now on loan to the Imperial War Museum, which is in itself a tribute to their accuracy and workmanship.

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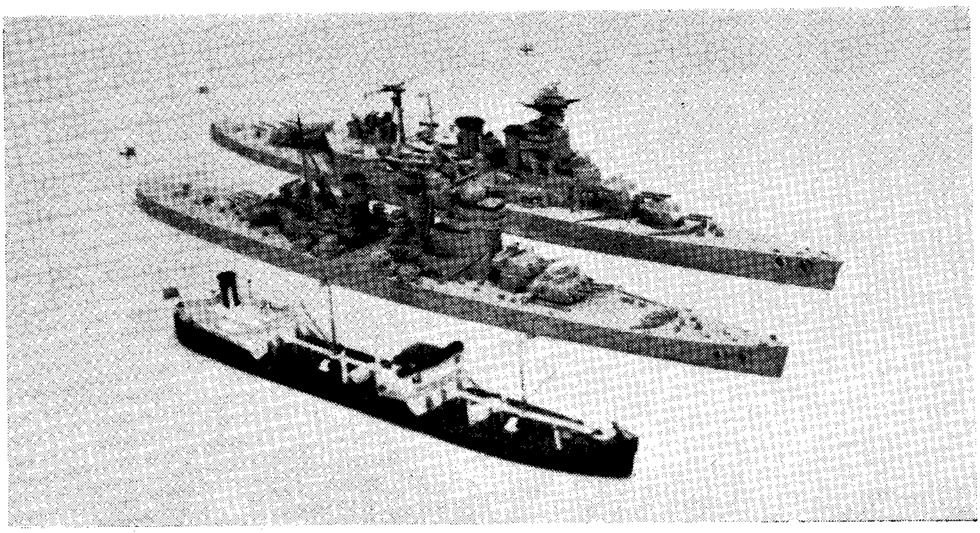
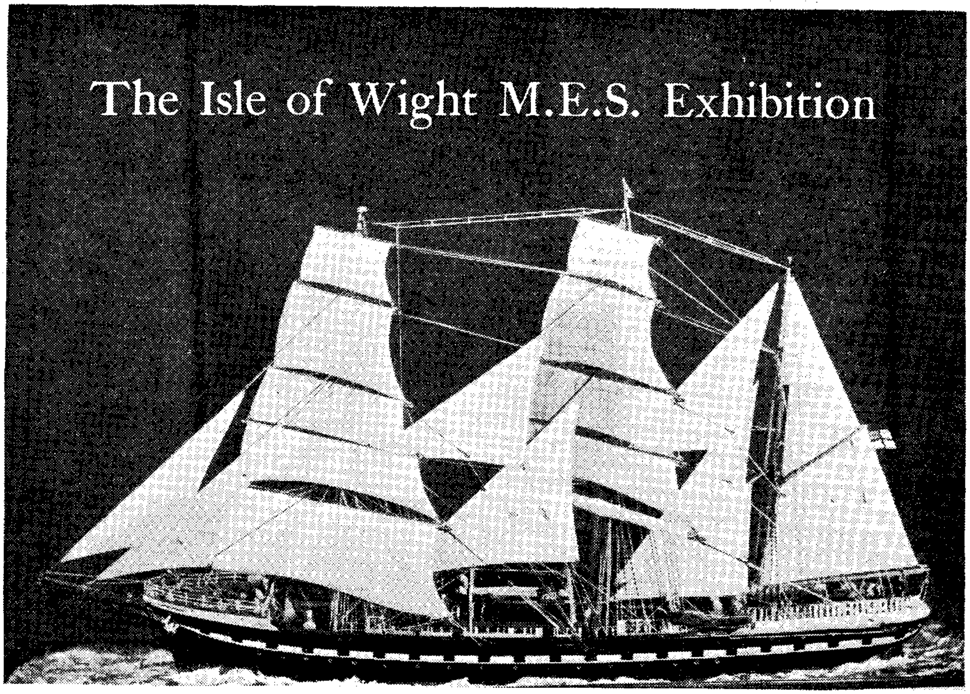


Some interesting water-line models by Mr. W. R. Finch

The Isle of Wight M.E.S. Exhibition



Mr. C. Gregory's model of the " Fantome II " in full sail

THE Society's annual Exhibition concluded on April 12th after a very successful four days, in which over 2,000 people paid to see fine examples of craftsmanship by the members and visitors of the above Society. The Society's Championship Cup was won by Mr. C. Gregory (Cowes) with his fine model of the *Fantome II* in full sail. The other awards were as follow :—

Locomotive Section : 1st, Mr. S. Slade (Cowes), with his 2½-in. gauge G.W.R. saddle-tank. (This locomotive performed valuable passenger work during the latter part of the Exhibition). 2nd, Mr. W. Gammage (Cowes)—boiler for " 1000 " class G.W.R. 3½-in. gauge locomotive.

Power Boats : 1st, Dr. H. S. Drummond (Yarmouth)—twin-cylinder steam launch. 2nd, Mr. Hobbs—launch.

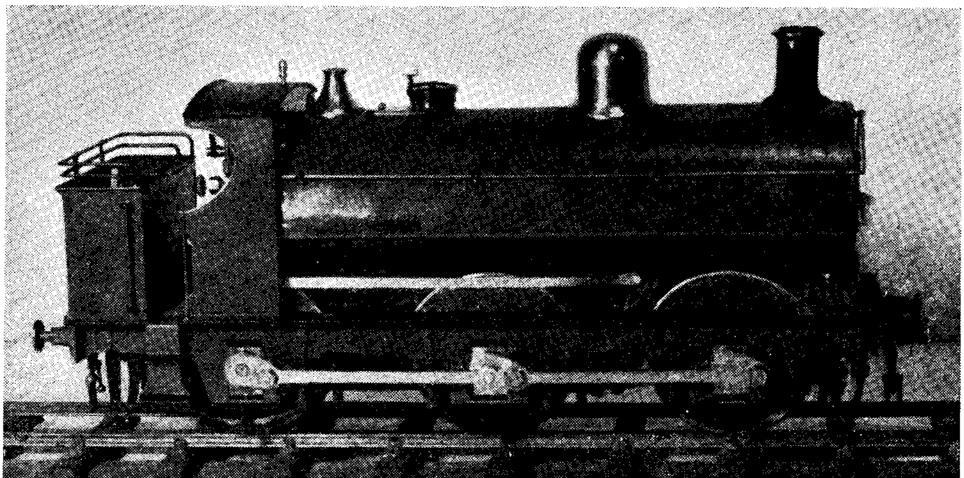


Photo by] [*J. Butler*

Mr. S. Slade's 2½-in. gauge G.W.R. saddle-tank locomotive

Sailing Craft: 1st, Mr. S. L. Cocks (Ryde)—three-masted topsail schooner. It may be of interest to visitors to Ryde during the summer to mention that this model can sometimes be seen in full sail on Sunday mornings. This boat is named *Emma Ernest*.

Aircraft (*Flying*): 1st. Mr. H. Hebor (Cowes)—rubber-powered "Dorland." (*Solid*): 1st, Mr. C. A. Wooldridge (Cowes)—D.H. "Tiger Moth."

The "Visitor's" Cup was won by Mr. E. C. Crabb (Ryde), with his "Tribal" class destroyer, H.M.S. *Afridi*.

Other outstanding models included old-fashioned steamers by Mr. G. Weeks; air-sea rescue launch by P. Jewel (junior member); a number of finished parts for "Hielan' Lassie," by Mr. P. Shotter, and a similar display of parts for "Fayette" by members of Messrs. Saunders-Roe Apprentice Training School (average age about 16½ years).

Messrs. J. S. White & Co. kindly exhibited the "Noah's Ark," with which they took 1st prize recently in London. (Incidentally, the model-maker for J. S. White is a member of the Isle of Wight Model Engineering Society); also a fine model of H.M.S. *Contest*, the first all-welded destroyer.

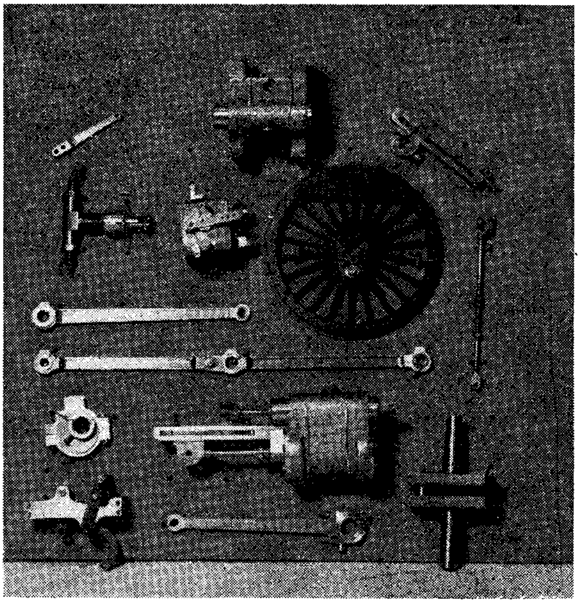


Photo by] [*J. Butler*
Some component parts of Mr. P. Shotter's "Hielan' Lassie"

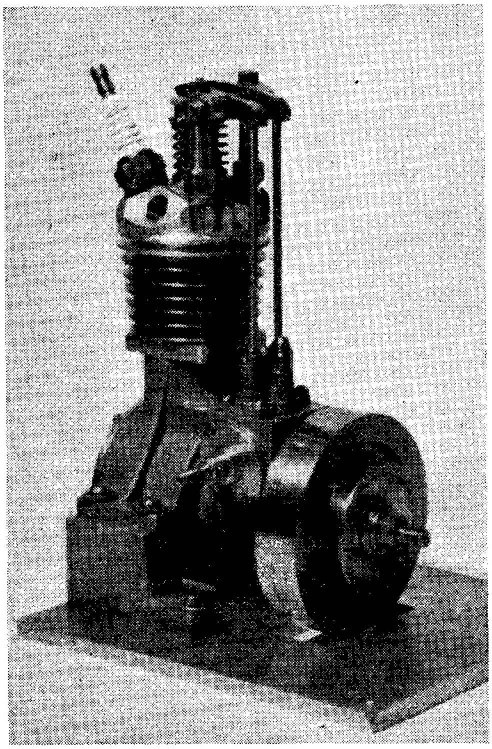


Photo by] [*J. Butler*
Dr. H. S. Drummond's "Apex Minor" 15-c.c. o.h.v. 4-stroke engine

Messrs. Saunders-Roe showed in the Aircraft Section a 1-in-24 scale model of the new Saunders-Roe flying-boat, the S.R. 45, which will weight 130 tons and carry 100 passengers. Another model of the S.R. A1, the first jet-propelled flying-boat, was also exhibited by this company.

Portsmouth Model Engineering Society also exhibited a fine show of models. The centre of interest was around Mr. S. Summerscale's chassis of his 3½-in. gauge "Silver Jubilee."

Andover and District Model Engineering Society contributed with Mr. Pemble's "His Master's Voice" show train.

The prizes were presented by Mr. W. Hoare, Vice-President, who congratulated the winners on the quality of their workmanship, which is encouraging as an indication that we are getting back the craftsmanship which has lain dormant so long.

"Play-time Work"

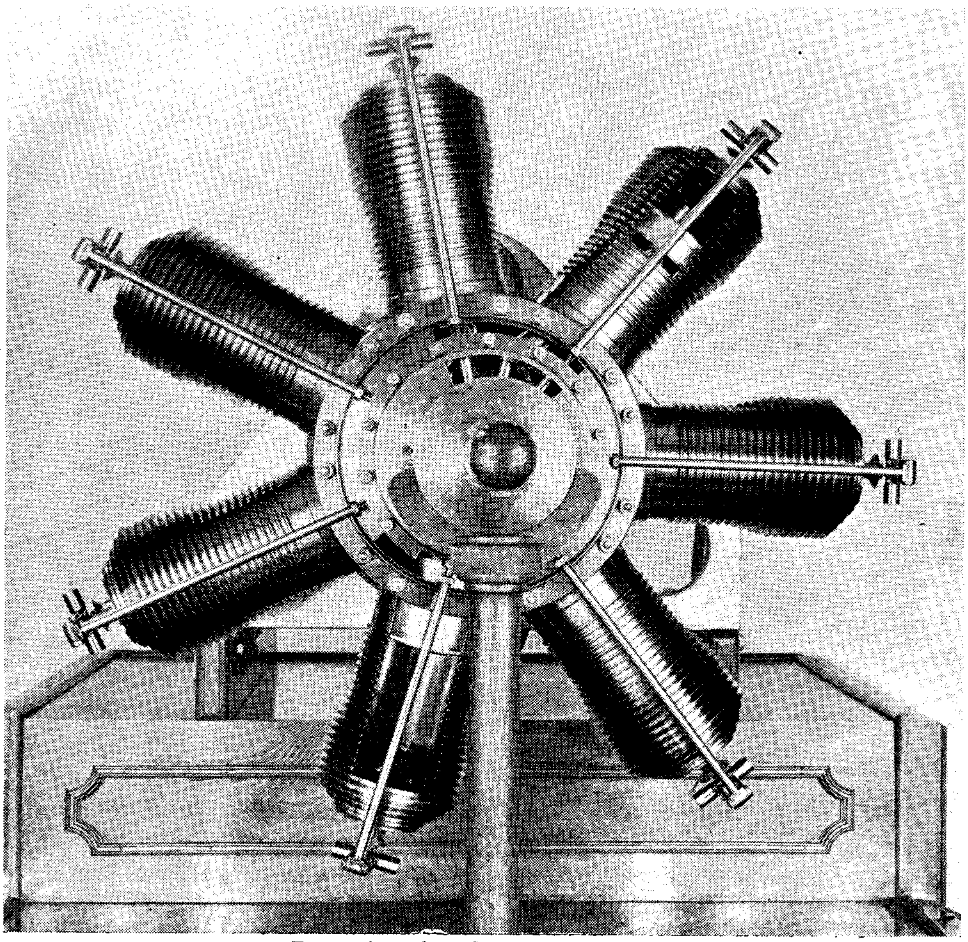
We are informed that an Exhibition under the title of "Play-time Work" is to be held in Exeter at an early date. The purpose of the Exhibition is twofold—(1) to demonstrate the wide range and high standard of hobby craftsmanship, and (2) to emphasise the value of constructive relaxation as a defence against the strain of modern life. The net proceeds at the exhibition will be devoted to the St. Loyes College for the Training and Rehabilitation of the Disabled. All types of exhibits will be welcomed. The Hon. Secretary is Miss Ruth Buller, Downes, Crediton, Devon.

WHY NOT A MODEL ROTARY?

by Edgar T. Westbury

MANY model engineers have been fascinated with the idea of the rotary-cylinder engine—by which I mean an engine of the reciprocating type in which the structure and working parts change places—in other words, the parts which are normally stationary rotate, and *vice versa*, forming a mechanical demonstration of the Law of Relativity. Engines of this type have been made to work by steam, compressed air, hydraulic pressure, and internal combustion; and as most readers are aware, examples of the latter class played a very important part in the conquest of the air, though they are now completely extinct.

I have seen several more or less complete or elaborate imitations of the rotary type of aircraft engine made in a miniature form, as dummies or to work on steam or compressed air; but few model engineers have ventured to go all the way and make them as proper internal combustion engines. This is not surprising, in view of the practical snags which experimenters have encountered in any kind of multi-cylinder engine of small size; and it is only within recent years that the possibility of reducing cylinder capacity to a size sufficiently small to make a reasonable miniature of this type, has been demonstrated.



Front view of 50 *h.p. Gnome engine* (1908)
(*Crown copyright. From an exhibit in the Science Museum, South Kensington*)

But many of my correspondents have given a lot of thought to both radial and rotary engine design, and a recent long and interesting letter from a reader in the Midlands is typical of many in which the latter type of engine is the topic of discussion. I have taken the liberty of paraphrasing and abridging his letter.

"On reading your article on 'Multi-cylinder Developments' in the issue of THE MODEL ENGINEER, dated December 12th last," he writes, "and after seeing the illustration of Mr. Gerald Smith's excellent 18-cylinder radial engine, I feel prompted to draw attention to another type of engine which seems to have been completely neglected—namely, the rotary type, as exemplified by the Gnome and several other engines used in aircraft in the 1914-18 war.

"I had formerly considered the modelling of this type of engine too formidable a proposition even for the most ambitious model engineer, but after reading of Mr. Smith's and Dr. Fletcher's engines, I begin to think there are possibilities in this direction. By a coincidence, a little time after the above article appeared, I came across a book on engineering drawing in the local library, among the plates in which was one showing the 100 h.p. Monosoupape Gnome rotary engine, together with a short description. The information, though somewhat scanty, proved so interesting that I thought that some further particulars would be of general interest to other model petrol engine constructors, especially as some of the principles may be applicable to more orthodox types of engines.

"As the dimensions of the engine were given in metric terms, I have converted them into the nearest equivalent English measurement for the convenience of those interested. The bore and stroke of this engine were $4\frac{3}{8}$ in. and $5\frac{5}{8}$ in. respectively; the cylinder was machined from a cast steel forging, head, barrel and fins all being turned from the solid. A remarkable feature was the extreme thinness of the cylinder walls, which were only 0.059 in. thick. The lower portion of the barrel was provided with flanges which engaged grooves turned in the seatings of the split crankcase, the cylinders thus being clamped between the front and rear halves, studs and nut for securing the cylinder being thus eliminated. Keys were fitted to prevent the cylinders from rotating. A light boss was welded into the cylinder head to take the sparking plug.

"The single large valve was centrally disposed in the cylinder head, and measured $2\frac{1}{2}$ in. across the head; it was fitted with a leaf spring and operated by a roller on the end of a rocker arm, actuated by a rod from tappets in the crankcase. Its seating, which embodied the rocker bracket, was made from a forging, clamped in the head by a screwed locking ring. The piston was of cast-iron, elaborately ribbed, machined to a very thin section, and fitted with one ring of normal type, plus a special ring known as an 'obturateur' ring."

My correspondent goes on to discuss further details of this and other engines, many of which are punctuated with a question mark, and in one or two cases evince some slight misapprehension, as he admits there are many points on which he is not at all clear. He concludes by saying:

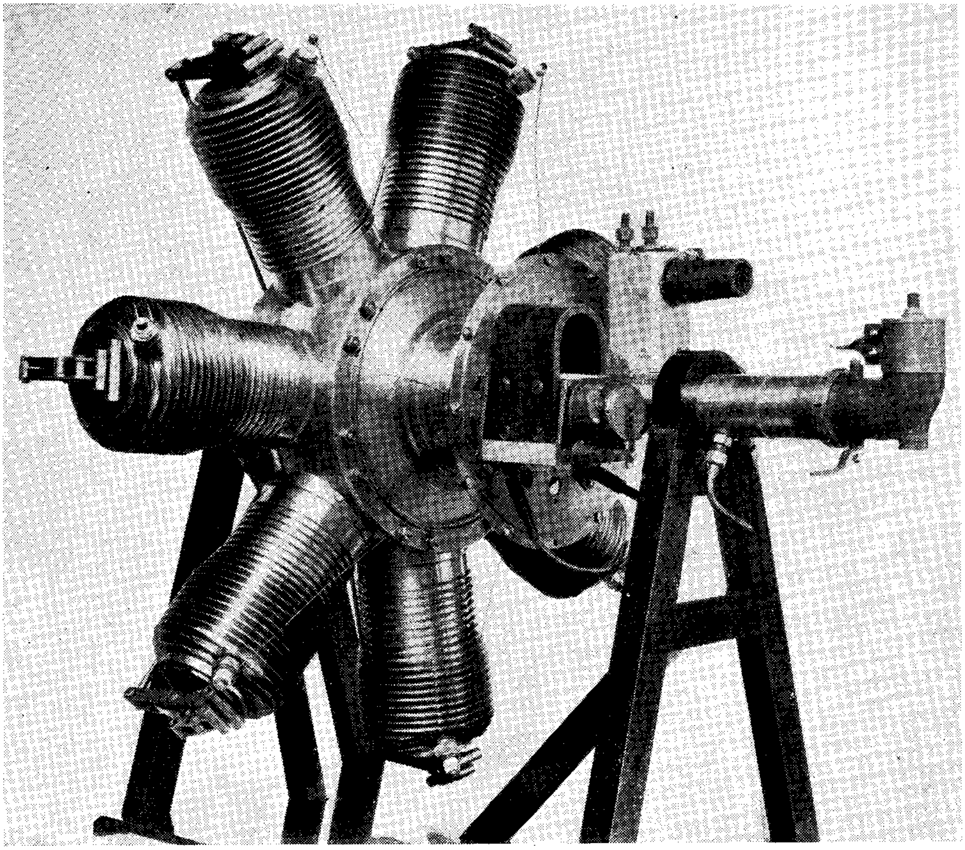
"I do not know whether you have had any experience with this type of engine, or whether you consider it, and its working principles, to be too antique to warrant discussion; but I know that everything connected with research is sure to meet with your approval, and I hope you may be persuaded to make some comments on these interesting and ingenious engines in 'Petrol Engine Topics'."

Well, to deal with last things first, I certainly have had experience with rotary engines in the past, and I do not consider any engine or its working principles to be too antique for discussion; in fact, no mechanical principle is ever completely obsolete, and although it may die out in one form, it is almost certain to crop up in another, sooner or later. So, far from having to be persuaded to comment on these engines, the real danger is that I may be tempted to loose a flood of reminiscence about them, which can only be stemmed by the Editor's blue pencil.

There is no doubt about the attraction such engines offer to the lover of ingenious mechanism, though their advantages suggested by my correspondent may be largely fallacious, or cancelled by many serious faults and limitations. From the purely practical angle, the static radial type of engine—which pre-dates the rotary, and still survives in a very healthy state at the present day—is a much better engine, and presents fewer headaches in design. But as I have often pointed out, petrol engine builders do not have to be for ever anchored to utility considerations, but should be quite prepared to model an engine for the sake of its interest alone. What builder of a dignified historical side lever, steeple or beam engine ever worries whether it is as efficient as the modern type of steam engine? If we are to be true model engineers, it is the engine that matters, not the job to which it can be harnessed.

The rotary engine undoubtedly marked an epoch in the history of aviation, and supplied an early need for an engine of high power/weight ratio, which made all the difference between success and failure in many of the aircraft of the period. It was condemned as a mechanical nightmare by many practical engineers when first introduced, but *it did the job*; and as it was one of the first types of engines to get into a stabilised state of development by the time war broke out, it was adopted for use in most of the lighter classes of scouts, fighters and reconnaissance craft. I have vivid recollections of the old Avro biplanes fitted with the 100 h.p. Monosoupape engine, which, after distinguished war service, were used for trainers for some seven or eight years after the war, under the affectionate nickname of the "Flying Crab." But an even earlier contact with this type of engine was in a job with a firm making components for them, including cylinders, in respect of which, I can substantiate the statements made regarding the light section of the finished job.

Speaking from memory, I believe the billets of steel from which the cylinders were machined weighed about 60 lbs. when received in the rough, and finished up weighing about $3\frac{1}{2}$ lbs. The material was extremely difficult to machine with the tools then available—there were no super



Rear view of 50 h.p. Gnome engine, showing magneto with distributor ring, carburettor and oil feed pump
(From an exhibit in the Science Museum, South Kensington. Reproduced by permission of Sir F. K. McClean)

high-speed steels or tungsten carbide in those days—and the mortality rate of the slender tools used for forming the fins was extremely high. Altogether, this job was not exactly a popular one in the machine shop, and some of the other components of the engine were not much easier.

Valve Operation for Gnome Engines

The original form of Gnome engine, which, as far as I am aware, was the first successful rotary to be used on aircraft, had its exhaust valve located in the cylinder head, and the inlet valve in the piston, as illustrated in Fig. 1. The latter served as a transfer valve from the crankcase to the cylinder, and was operated automatically by the difference in pressure between the two sides on the suction stroke. In this, and most other rotaries, the stationary crankshaft formed the induction pipe, and the carburettor was attached to its rear end. It was necessary to provide measures to counteract the centrifugal forces on the valves and their operating gear, and it will be seen that the inlet valve was equipped with pivoted counterweights to balance its mass and prevent it flying open, while the exhaust valve rocker was actuated by a tension rod—the reverse of the push rod normally employed on o.h.v. engines—the inner end of which operated a subsidiary rocker through roller contacts. Timing of the exhaust valve on this type of engine was more or less normal, and the whole of the air-fuel mixture entered the cylinder through the automatic inlet valve in the piston.

A good deal of trouble was experienced through the sticking or mechanical breakdown of the elaborate mechanism of the inlet valve, a not uncommon occurrence being explosion or fire through the ignition of the entire volume of combustible mixture in the crankcase. The later form of the Gnome engine was the Monosoupape (single-valve) type, in which there was no valve in the piston. (Fig. 2.)

As the operation of this type of engine is somewhat of a mystery to many people, a few words about it may be of interest. The single valve in the head acted not only as an exhaust valve, but was used also to take in the bulk of the air required for combustion; the fuel,

mixed with a small amount of air, was admitted from the crankcase by way of a ring of ports uncovered by the piston at the bottom of its stroke. For this reason, the valve remained open for practically a complete revolution of the engine, opening a little earlier, if anything, than a normal exhaust valve, and closing some

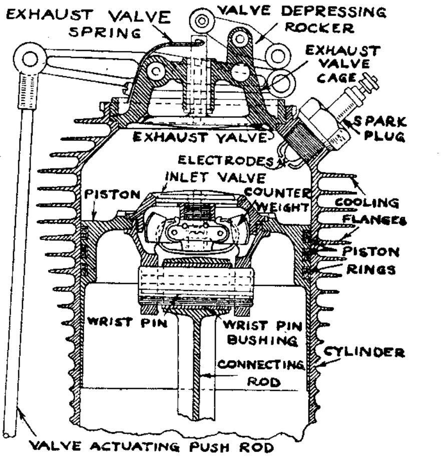


Fig. 1. Section of 50 h.p. Gnome engine cylinder, showing automatic inlet valve in piston

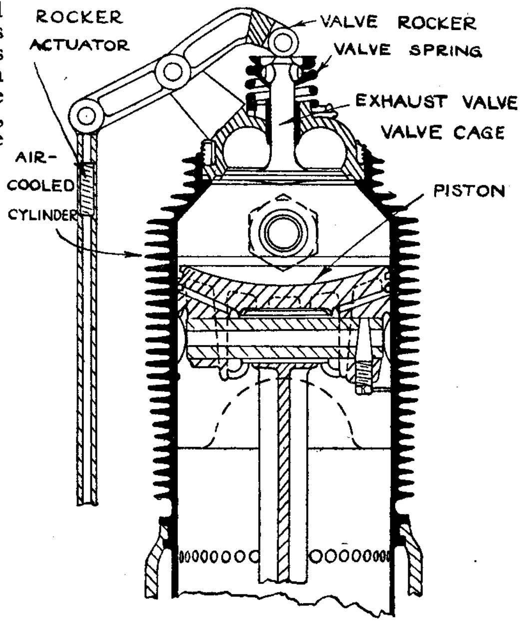


Fig. 2. Section of Monosoupape engine cylinder, showing single valve in head and row of transfer ports around base

time before the completion of the inlet stroke; the remainder of the stroke produced a partial vacuum, which served to draw in the rich air-fuel mixture through the cylinder ports.

It will be fairly obvious that an engine of this type could not be fitted with an exhaust pipe, as this would result in drawing back the products of combustion into the cylinder instead of pure air. Another point is that early exhaust opening was a necessity to prevent gas, or possibly flame, being forced into the crankcase when the ports were opened at the end of the firing stroke.

Under normal running conditions, crankcase fires or explosions did not occur with the Monosoupape engine, because the mixture in the crankcase was too rich to ignite; but they could and did happen if the mixture became weak, due to partial choking or cutting off of the fuel supply. For this reason, engine control relied more upon the ignition switch than anything else, and "blipping" was the accepted method of controlling speed anywhere below a fairly narrow range.

(To be continued)

MAKING A SLIDE VALVE-SPINDLE

I HAVE found the following an easy way of making a valve-spindle which allows for some adjustment, even under steam.

The method may not be very new, but, so far, I have not seen it adopted by anyone else.

On the piece of rod selected for making the valve-spindle, two small steel washers are brazed, so that the valve back, after slotting, will slip in between them.

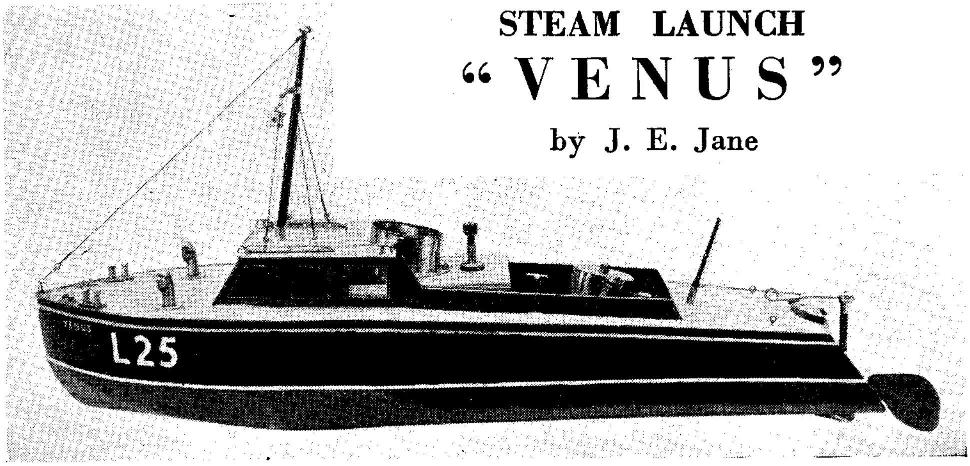
If, by chance, more brazing material has been applied than necessary, the spindle can be put into the chuck and the washers turned up on their inner faces so that the valve will fit as required.

The washers must be of a diameter so that they will pass through the hole in the back end of the steam-chest which will accommodate the dummy gland, or a packed gland can be used.

The adjustment is by screwing the valve spindle in or out of the fork without disturbing anything. The fork is provided with a long collar and is afterwards secured with a lock-nut.

It will be noticed that just the one slot in the valve back is all that is required, instead of having to provide a cross-slot to accommodate a nut.

The idea also cuts out the job of filing two flats on the spindle, and the valve is free to drop on to the port face, and there is no need to reduce the diameter of the spindle to pass through the tail gland.—C. V. BAVIN.



STEAM LAUNCH "VENUS"

by J. E. Jane

THE building of this model was the outcome of a rather quick decision taken one Sunday afternoon, whilst "day-dreaming" ; one of those periods when one starts thinking of several ideas without coming to a conclusion on any of them.

At this moment, my eyes happened to settle on a small power unit lying on a side table. This little engine and boiler, which I had been making during odd moments, had only been finished about three weeks previously. Instantly, I thought that it was about time that it was put to the use for which it was meant. No sooner was the idea visualised, than the deed was done ; out came my pencils, paper, rules and drawing board, and the " Venus " was born.

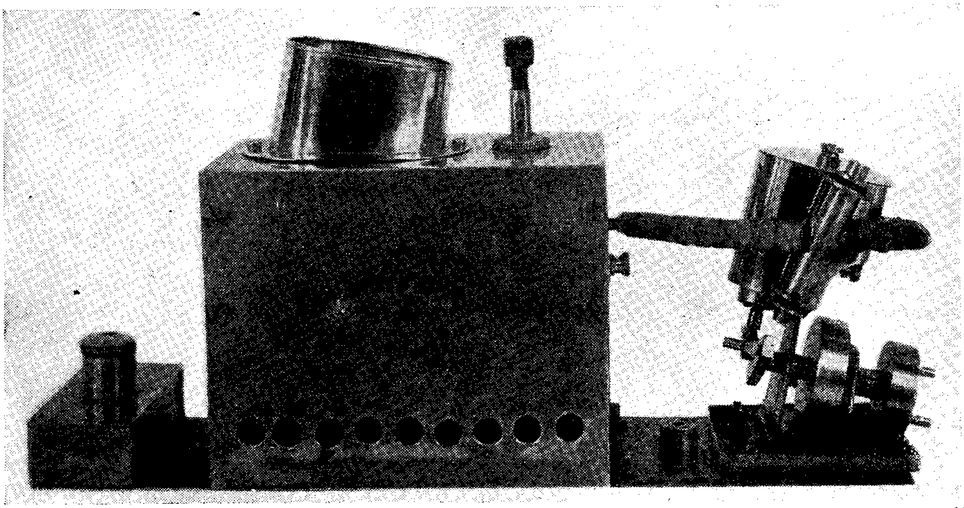
Having made and completed my first boat some months previously, the designing of this one did not prove quite so difficult. Nevertheless a few headaches were " gotten " before a satisfactory drawing was completed. I worked to the full scale on paper. Therefore the drawing was the actual size of the " boat to be," the scale being ½ inch to 1 foot.

Materials decided upon, for construction were sheet tin, brass, aluminium and steel, with a yellow pine dowel for the mast.

The whole job was completed in about three months. Unfortunately the weather being what it was, I was unable to run a trial until quite recently, when the results were quite favourable. The weather conditions on this occasion were superb, so I was able to let the boat have its fling. The speed was not by any means excessive, about two knots being its limit. The running time was twenty-five minutes. With no wind about, the response to the rudder was very satisfactory.

For the purpose of obtaining the required lines, I traced my original drawing on to some brown paper, pasted it to the tin, and cut around the lines with the shears. (This method certainly seemed to minimise the amount of filing required for the purpose of " trueing " up). It was then bent into shape and soldered together. The transom plate was then cut out and soldered into position. Next the centre line was marked out and a hole drilled to receive the stern tube.

The Main Deck was then made, being cut



The power plant

from a separate sheet with provision for the cabin, cockpit, and ventilators.

Cabin. Templates were traced for the cabin, pasted on to the tin, and cut out. The window positions were then chiselled out, filed to the scribed lines, and cleaned off. The top edges of the cabin walls were "lipped" over for the purpose of receiving a sliding roof. The cabin, in sections, was now soldered to the main deck. Beading of $\frac{1}{16}$ in. brass wire was then cut and shaped to fit the edge of the main deck and cockpit, but was not soldered into position until practical completion of the boat, prior to painting.

The remainder of the deck components, were now put into position and soldered.

The hull was once more attended to. An hour spent in the bathroom satisfied me on the question of buoyancy, and the power unit location. The completed main deck was then placed temporarily in position and the boat checked for "water-line" position. These details having been ascertained, and attended to, the work of fitting the propeller tube, stern tube, and the soldering of the main deck commenced. (Needless to say, this was not done in one night, but was spaced over a period of a couple of weeks.) The boat, being now more or less complete, the wire beading, previously mentioned, was then soldered on, cleaned up and polished (as it was intended to be left bright). The propeller shaft and rudder were fitted, and the propeller screwed on.

A power test being now indicated, I pumped some grease in the tube, collected some "meth.", filled up with water, and once more repaired to the bathroom. The engine "got going" in good time, and ran for some twenty-five minutes, before the "meth." ran out.

Details of Painting

Main Deck and Sliding Roof: Light ivory. *Cabin walls*: Brown. *Hull*: Upper part, black, with $\frac{1}{8}$ in. buff line, lower part, red, with white water-line. *Mast*: Stained walnut colour. Note :—All lines, number and name were hand-painted.

Power Unit : Engine

Oscillating, single acting, one cylinder, made from brass tube $1\frac{1}{2}$ in. long, $\frac{7}{16}$ in. inside diameter. *Piston, Rod* and *Big End*: ground from one solid piece of steel $\frac{1}{2}$ in. diameter. *Flywheel*: from $1\frac{1}{2}$ in. round brass. *Universal Drive*: from a brass disc. *Engine Support*: shaped from one piece of sheet iron 22 gauge. *Face Block*: of brass, sweated to frame. *Displacement Lubricator*: from $\frac{3}{8}$ in. dia. brass tube, located on the main steam pipe. *Steam Pipe*: $\frac{1}{8}$ in. inside diameter, copper. *Exhaust*: $\frac{1}{4}$ in. inside diameter, copper, connected by rubber-tubing to exhaust outlet on boat. *Brass "Splash"*: Cover fashioned from sheet brass, fitted over cylinder, to prevent oil and water splashes to side of boat. *Boiler*: Copper tubing, $4\frac{1}{2}$ in. $\times$ 2 in., fitted with external water tubes of $\frac{1}{4}$ in. dia. copper. A $\frac{1}{8}$ in. dia. brass rod passes through from end to end, and protrudes for $\frac{1}{2}$ in. at either end. These rod ends were screwed 5 B.A., and are used for supporting the boiler casing. *Inner Boiler Casing*: of 20-g. sheet iron. *Outer Casing*: of aluminium. *Outer Funnel*: fashioned from sheet brass, and

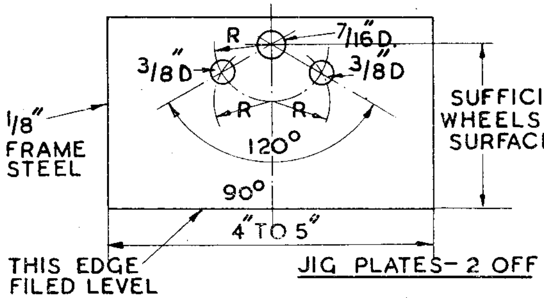
(*Continued on page* 694)

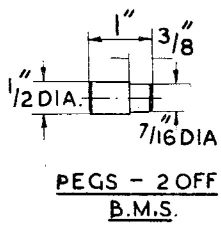
Mr. Jane's smart steam launch, "Venus"

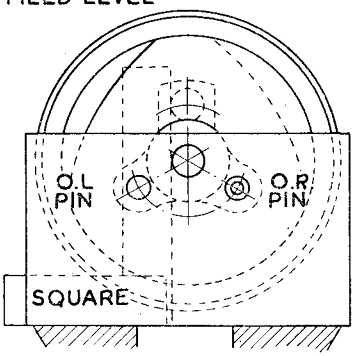
SETTING CRANKS
AT 120 DEGREES

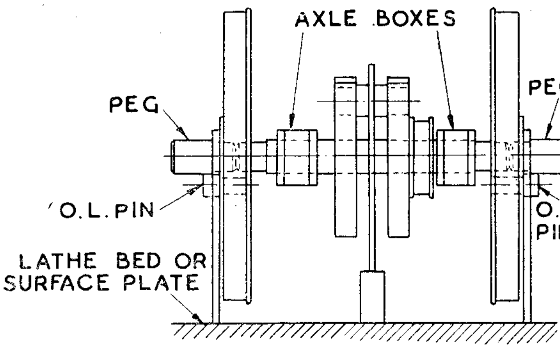
by Philip Cox

DURING the building of my 3½-in. gauge "Pacific," I was faced with the task of setting the crankpins at 120 deg. to each other. I didn't fancy the set-square method, so the grey matter was stirred around and the following method was finally evolved.









plates stood on edge on the lathe bed, the centre crank was put somewhere near the vertical. A try-square on the lathe bed was used to finally set the crank. This was an easy matter, because the crankpin and the axle are the same diameter, and the centre portion of the axle between the webs had been left in for this purpose. The solid axle kept the assembly stiff while the wheels were being pressed on. After checking round to make sure that everything was so-so, the plates were removed and both wheels pressed on together in the bench vice. The centre portion of the axle was cut out and that part of the job was finished.

Two pieces of ⅛-in. frame steel were filed flat along what was to be the bottom edge, one plate was then marked out, using the well-known piece of geometry to obtain the angle between the holes. The two plates were next clamped together—taking care to keep the prepared edges level—and the $\frac{7}{16}$ in. diameter hole drilled and reamed. Then, using the jig made to drill the crankpin holes, the other two were drilled, opened out and reamed ⅜ in. diameter to take the crankpins previously pressed into the wheels. All that remained was to turn a couple of locating pegs out of a bit of ½-in. B.M.S., a push-fit in the plates and wheels. This completed all the jig making necessary.

I now needed some flat surface; what better than the lathe bed? So to this I turned. The crank-axle was dealt with first. A wheel was mounted on each plate, being located with a peg and the crankpin; I took care to get the crankpins in the right holes, that is 120 deg. apart, then the wheels were pushed on to the ends of the axle—not forgetting the axle-boxes. With the plates stood on edge on the lathe bed, the centre crank was put somewhere near the vertical.

The other two pairs of wheels received similar treatment, but with these there was no crank-axle to deal with.

On some three-cylinder engines the inside cylinder is more steeply inclined than the two outer ones and this makes it necessary to advance the inside crank relative to the other two. The method I have just described can be successfully employed, but to set the crank-axle make a gauge similar to a try-square, but with the upright blade set over from the vertical by an amount equal to the difference in the incline of inside and outside cylinders.

In conclusion, I should like to say that the free running of my engine certainly justfied the small amount of jig making necessary.

CONCRETE FACTS

by L. G. Tucker, A.M.I.C.E.

MANY model engineers must, from time to time, come up against small "civil engineering" jobs of one sort or another, a concrete floor in the workshop, or the construction of a garden railway or model speedway track. I would like in these notes to try and give some useful information on the subject, in the hope that it may be of assistance.

Concrete

This material is used for many purposes by model engineers, and careful regard to certain principles will result in much stronger material without increasing the cost. Many text books may tell you to use a mix of say, four gravel : two sand : one cement, but do not generally stress the important point, and that is, the amount of water to be used. It is a definite fact that the less water that is added, the stronger will be the concrete, and this factor probably has more bearing on the strength than any other. The amount of water in the mix, including what is already in the gravel and sand, should, if possible, be kept down to about half that of the amount of cement used, measuring by weight and not by volume. This may, I realise, give a dry mix and cause the work of laying the concrete to be harder, but it *will* give added strength. If you must use a wetter mix then also add more cement, keeping the water/cement ratio as half. To illustrate my point as to the strength depending upon the water/cement ratio the following figures may be of interest; all apply to the same mix in so far as the ratios of gravel, sand and cement are concerned, and to fully compacted concrete.

Water/cement ratio ..	0.3	0.5	0.7	0.9
Compressive strength in lb./sq. in. at 28 days	8600	5400	3200	1900

The choice of gravel and sand is of less importance and an "all-in" or "as-raised" ballast can be used provided that it is reasonably clean and not too sandy; if can even be used when it is "oversanded" provided that the water/cement ratio is kept correct, but the resultant concrete using normal proportions of cement will be too dry to work easily, and this is a case where an increased quantity of cement, and hence, of water, is recommended.

It should be noted that if an "all-in" ballast (this term is applied to the mixture of gravel and sand, as dug out of a pit, and which is not sieved or screened) is used instead of separate gravel and sand, the proportions of the mix will be different. Let me explain it in this way, the gravel, (i.e., stones of size $\frac{3}{16}$ in. and upwards) has a percentage of voids in it; the amount of sand added is approximately equal to the volume of these voids; with a 4 : 2 1 mix, the two parts of sand (by volume) are added to the four parts of gravel (by volume) and you will, theoretically, have only about four parts of the combined mixture; this varies quite a bit, of course, with different gravels and for really high grade concrete, tests are made beforehand to ascertain the exact proportions. In actual practice the amount of sand added is such that in the example quoted above you would probably after adding the sand find that you had four-and-a-half parts of the combined mixture; this applies in the case of most ballast in this country. But "all-in" ballast is gravel and sand already mixed and the equivalent mix when using this would be, say, four-and-a-half parts of "all-in" ballast to one part of cement. Confusion is often caused by referring to six-to-one concrete; some engineers would mean four gravel plus two sand to one cement, others would mean six gravel plus three sand to one cement, or with "all-in" ballast, six ballast to one cement; and it is well to be clear on this point.

Mixing

In the actual mixing I think that the old rule "Turn over twice dry and once wet" is a good one for hand mixing; the mixing of the materials in their dry state first before adding the water is certainly important. Another factor which influences strength (and durability) is the amount of compaction achieved; the concrete must be rammed down hard, using a heavy punner or heavy wood plank or tamper, so that no air bubbles remain in the concrete. Too often is an apparently nice finish obtained, say, to a concrete floor by using over wet concrete, and then working with a light tamper, bringing all the "fat" up to the top; this may give a smooth surface, but it is one that will wear quickly, always be dusty, and the concrete itself will be porous, will lack strength, and be very liable to damage by frost.

Curing

After it is laid, concrete requires curing; once the initial set has taken place, cover the concrete with sacking or straw, and keep it soaked in water for seven days. A concrete floor will also benefit from about three applications of sodium silicate (one part sodium silicate to five parts of water) sprayed on liberally; this renders the concrete less pervious to grease, etc. Never, of course, lay concrete in frosty weather, the precautions that have to be taken to enable it to be done in such weather are too extensive for amateur work.

Reinforcement

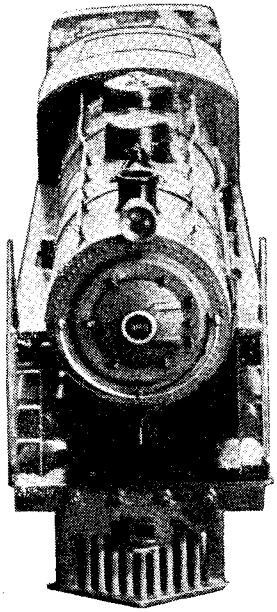
For reinforced concrete, do not use galvanised iron or steel, the concrete will not adhere to it properly. Do not mind the iron or steel being a bit rusty, provided that there is no loose scale on it; the concrete will adhere to it all the better.

In normal work steer clear of rapid *setting* cements; use rapid *hardening* if you like.

(*Continued on page* 698)

BUILT AT SEA

Mr. B. Bagnall constructed this excellent example of "Hollywood Annie Boddy" while stationed in the Pacific



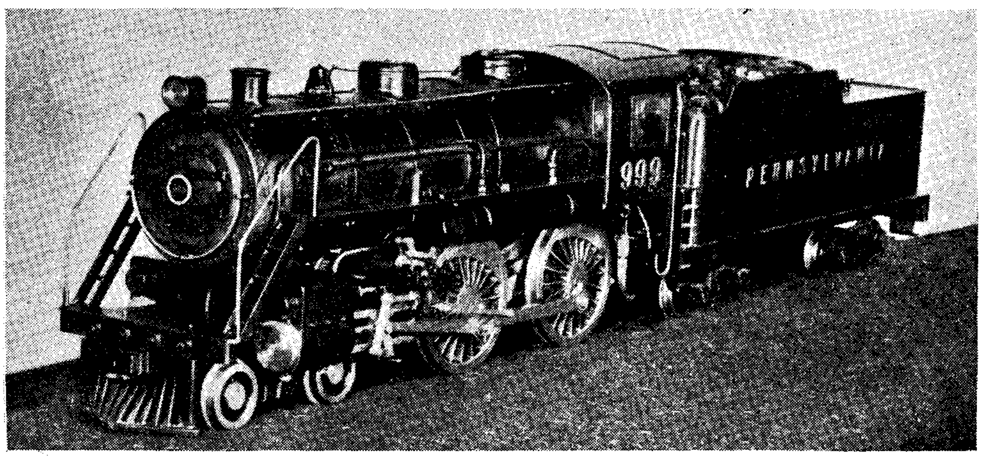
IN 1945, we published two contributions submitted by Petty-Officer B. Bagnall; one appeared in our issue for May 3rd, 1945, and described a first attempt at constructing a small petrol engine; the second article appeared in the July 5th issue, and described a simple vertical engine made for his young son.

Almost immediately after sending in those two articles, Mr. Bagnall sailed for the Pacific; but he evidently had in mind the construction of a ½-in. scale locomotive while he was away, because he took with him castings for cylinders and wheels, a drawing carefully removed from a bound volume of THE MODEL ENGINEER, a quantity of silver-steel and a collection of MODEL ENGINEER taps and dies.

He went to the East *via* the U.S.A., crossing the States by rail, and gathering a few American publications in New York and San Francisco. He also had the privilege of riding on the footplate of the engine for more than 100 miles; but that, apparently, is another story! On arrival in the Pacific, he found himself fortunate enough to be stationed on a repair-ship.

It seems that, on the principle that an enthusiastic model engineer is not daunted by unorthodox conditions, Mr. Bagnall set to work in spare time and produced the locomotive seen in the illustrations herewith. It is his first coal-fired engine and has hauled two passengers. The cylinder bores, however, are showing signs of under-lubrication, which may be due to long runs under compressed air, as well as to the use of a not particularly satisfactory arrangement of hydrostatic lubrication when the engine is in steam. These faults, and a few others not noticed before, are being rectified.

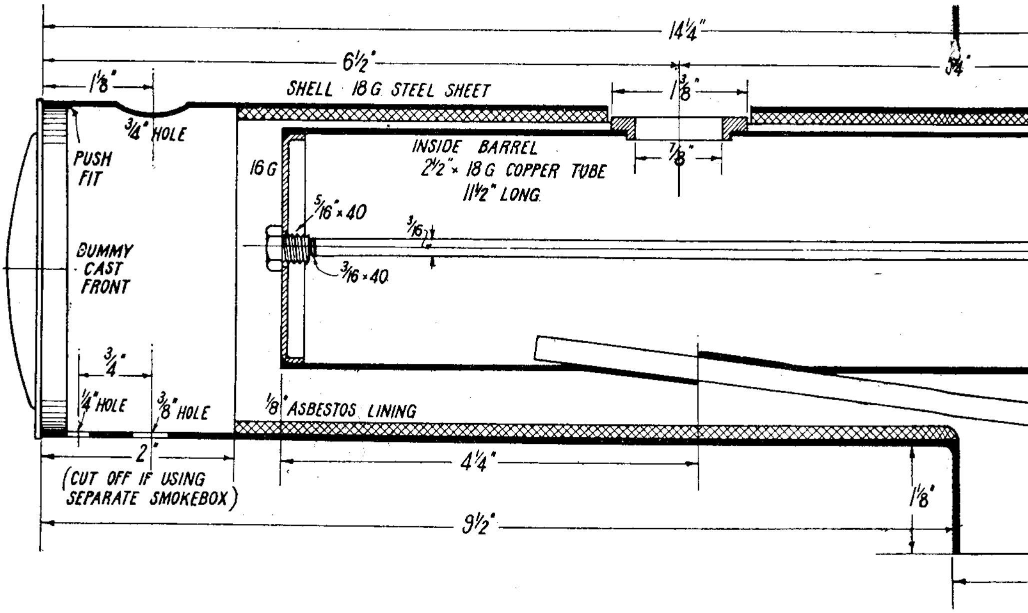
Mr. Bagnall returned to this country last September; but, due to the prevailing conditions, he has experienced great difficulty in restoring his workshop to its pre-war standard. However, the modifications to the engine are to be completed in order to make the fullest comparison between the methods employed at sea and in the home workshop. Then, we hope, he will let us have a detailed description of the construction of this engine in such interesting and unusual circumstances.



Mr. B. Bagnall's "Hollywood Arnie Body"

"L.B.S.C."— AN OIL-FIRED B

SOME of the builders who have completed the chassis of "Juliet" and intend to fit an oil-fired boiler, are saying "please don't make us wait until the description of the loco-type boiler is finished, or we shall be hung up for a job." All sereny, anything to oblige! So here is an illustration or two, with a few constructional notes, on the alternative boiler, which will enable them to "get cracking" as soon as they like.



Arrangement of oil-fired boile

Beginners might care to learn that in this boiler they once more have the result of practical experience in the actual work of locomotive building, embodied in the design and construction. Your humble servant has overhauled and rebuilt dozens of both commercially- and professionally-made engines with water-tube boilers, and in all of them there have been faults.

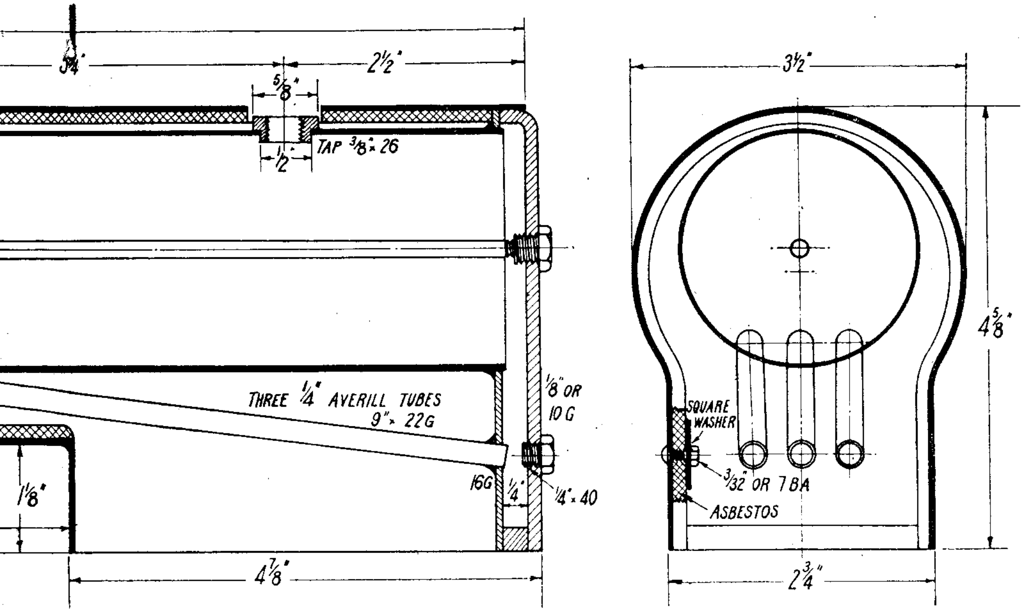
The chief fault of one commercial design in particular was the bunching together of a number of small-diameter water tubes, ranging from five to nine, these having a big swan-neck where they emerged from the barrel at the back end—which was good—then continuing almost to the extreme end of the barrel, right up close to it and parallel with it, which was jolly bad, and then finishing up by entering the barrel with an almost right-angle bend, which was worse still. When getting up steam with an oil-burner on one of these contraptions, it sounded like a machine-gun in action! The water in the horizontal part of the tubes being rapidly converted into steam, blew the rest of the water out of both ends and left the tube dry. As soon as the steam had gone, back came the water into the tube again; and immediately it reached the part of the tube in the lamp flame, it flashed into steam and the performance was repeated, until finally the tubes cracked or burst. After several experiences of this kind, I always fitted either a new inside barrel with three tubes only, much larger in the bore, or else cut the small tubes out, plugged the holes, and replaced them by three larger ones. Another fault was that the small tubes became furred up when the boiler had been fed with impure water, and promptly burnt out as soon as the oil burner got busy. With the original "poison-gas-plant" firing, they merely became red-hot, and contributed nothing at all to the steaming of the boiler.

Other boilers had a cast backhead with a water-space at the bottom, something like I have shown here, but retained the small tubes with the horizontal part and sharp bends at the front end. These did not kick up such a shindy as those first mentioned; but they rapidly burnt out, because any scale and dirt in the water settled at the bottom of the "downcomer," as it was called, and soon blocked up the rear ends of the tubes. One specimen had the downcomer blocked solid, right up to the barrel; I sawed it off, to see exactly what was in it, and that was what I found.

Other people realised the shortcomings of the usual water-tube boiler, and tried to improve it. The late Mr. T. W. Averill did away with the bends at the leading end, and by distorting the holes after drilling, he gave the tubes a straight

D BOILER FOR “JULIET”

run-in. This was an excellent idea which I perpetuated in all the water-tube boilers that I personally built; you see it on the reproduced drawing. Carson's introduced a cast backhead incorporating two water-legs, into which were fitted two large tubes (about $\frac{5}{16}$ in. diameter on $2\frac{1}{2}$-in. gauge locomotives), but they still retained the front bends, and there was no provision for cleaning. Several other attempts at improvement closed in with a piece of sheet copper, same shape, brazed in. This provided a water-space of the same area as the backhead. A hole for the end of the barrel was cut in the upper part, and the three water-tubes were fitted in holes in the lower part. The water-tubes were perfectly straight, and entered the barrel by Mr. Averill's method of distorted holes. This made the boiler very similar to the well-known Babcock & Wilcox



f oil-fired boiler for “Juliet”

came to my notice, but none of them got right to the bottom of the whole business. Anyway, I did a bit of experimenting, and found that by putting in the front ends of the tubes on Mr. Averill's system, and entering the rear ends, not at right-angles to the barrel, but on the slant (the forward and rear parts of the tube being at right-angles, with an easy connecting bend) there was a good circulation set up from front to back, and the tubes kept clean. I used a loco-type backhead of flanged copper, and brazed the inner barrel straight on to it. This type of boiler steamed wonderfully well, but it had one drawback, viz. the amount of backhead space available for fittings and mountings, was limited to the end diameter of the barrel.

The Final Development

To get more space for fittings—as much, in fact, as on an ordinary loco-type boiler, I took the combined-backhead-and-downcomer idea and made a few improvements. My backhead was of flanged copper sheet, as on a loco-type; the space between the edge of flange and backhead was

boiler, as far as working principles were concerned. By putting three cleaning-plugs in the backhead, right opposite the ends of the water tubes, they could be cleaned out, and freed from any accumulation of scale or “fur,” as easily as sweeping boiler tubes. Any deposit in the bottom of the water space could easily be removed, by stirring it up with a wire through the tube-cleaning holes, or through a special plug placed lower down, and then washed out with a jet of water. The water-space provided extra heating surface, equal to the door plate of an ordinary locomotive firebox; and to prevent as much as possible the usual waste of heat through the outer casing, same was lined with asbestos millboard. Such is a brief specification of the boiler required for an oil-fired “Juliet”; and here are a few notes on how to build it.

Outer Shell

The outer shell, comprising the barrel and firebox wrapper, is made from 18-gauge sheet steel, following the general instructions given for the copper loco-type barrel and wrapper, with

two variations. One is that the smokebox may, if you so desire, be in one piece with the barrel ; in that case, the barrel part will be 2 in. longer than the loco-type barrel. The end will be carried on a smokebox saddle of the usual type, and the front closed by a casting carrying a dummy door and hinges, this having a spigot turned to a tight push fit in the end of the barrel, and saving all the work of making a separate door and accessories. Secondly, there is no need to braze the joints ; if the lap joint and the throatplate flanges are nicely riveted with $\frac{1}{16}$-in. iron rivets (brass or copper will do, but iron ones are better for steel work) they will be quite O.K., as there is no water to leak out. Holes are cut in the top as shown, that for the dome being $1\frac{1}{2}$ in. diameter and $\frac{3}{4}$ in. for the safety-valve. If you are using one-piece construction, the chimney hole should be made $\frac{3}{4}$ in. diameter, the hole for the blast-pipe $\frac{3}{8}$ in. clearing, and for the steampipe $\frac{1}{4}$ in. clearing, the location of the holes being shown on the drawing.

If a separate smokebox, such as a "Petrolea" casting, is desired, make the barrel same length as that on the loco-type boiler ; that is, $7\frac{1}{2}$ in.

The shell is lined with $\frac{1}{8}$-in. asbestos millboard. If this is cut to size, and then wetted, it will bend readily into a tube without cracking, and when dry, will retain the shape of the boiler. The part inside the barrel will "stay put" if the edges are just butted together ; the part inside the firebox casing can be secured by four large washers, about $\frac{3}{4}$ in. square, made from the same stuff as used for the shell, and fixed by a 3/32-in. or 7-B.A. screw and nut through the middle, as shown in the cross-section. Cut away the asbestos, of course, where it blocks the dome and safety-valve holes, and leave about $\frac{1}{4}$ in. of the firebox casing clear at the back end.

Backhead

The backhead is made from $\frac{1}{8}$-in. sheet-copper, same as the loco-type, but allow for the flange to be a full $\frac{1}{4}$ in. depth, measured on the inside. File off any raggedness, so that the flange is smooth-edged all the way round, and of equal depth. Now cut a piece of 16-gauge sheet-copper slightly larger than the backhead itself ; in this, cut a $2\frac{1}{2}$-in. hole, and drill three $\frac{1}{4}$-in. holes, at the positions shown in the illustration. See that this is perfectly flat, and that the backhead flange, when same is laid on it, makes full contact all round. Next, cut a piece of $\frac{1}{4}$-in. square copper rod, and fit it between the backhead flanges, exactly as described for the foundation-ring of the loco-type boiler. Temporarily clamp the plate against the backhead flange, and put three rivets through plate, piece of rod, and backhead, same as described for the throatplate section of the foundation-ring of the loco-type boiler. Now lay the assembly in the brazing pan, plate down, and backhead on top ; if the plate springs away from the flange, either tie the parts together with some thin iron binding-wire, or put something on top that won't hurt by being heated. Apply wet flux all around the joint, and braze it, using easy-running strip, or else Sifbronze it. Don't use silver-solder for this job, as it will either melt or crack open when doing the barrel joint. Pickle, wash off, and clean up. Now put a $\frac{1}{4}$-in. drill through the tube holes, and make countersinks on the inside of the backhead ; follow up with a 7/32-in. drill, and tap $\frac{1}{4}$ in. by 40, working the tap through from the backhead side.

An alternative method of fitting the plate is shown in the small detail sketch. In this, the plate is cut to fit *inside* the backhead flange, and the bottom edge is bent in to meet the backhead, thus dispensing with the piece of foundation-ring. The backhead flange must be at least $\frac{3}{8}$ in. deep inside, for this form of construction, to allow for the $\frac{1}{4}$-in. water-space, and a little fillet of spelter all around the joint ; otherwise there is nothing to choose between either method of construction. If using the first described, leave the plate projecting beyond the backhead flange until the larger part of the brazing and silver-soldering is completed ; it can then be filed flush with the backhead flange before assembling into the outer casing.

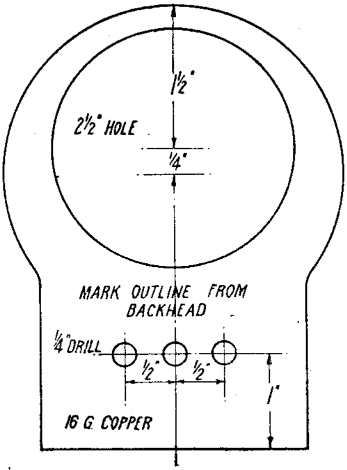
Inside Barrel

A piece of $2\frac{1}{2}$-in. by 18-gauge seamless copper tube, measuring $11\frac{1}{2}$ in. long after the ends have been squared off, is needed for the inside barrel. One end of this is closed by a flanged 16-gauge copper plate made exactly as described for the smokebox tubeplate of the loco-type boiler. Drill a 9/32-in. hole in the middle, and tap it $\frac{5}{16}$-in. by 40 ; drive the plate in flush with the end of the barrel. At $4\frac{1}{4}$ in. from the closed end, drill three $\frac{1}{4}$-in. holes at $\frac{1}{2}$-in. centres. As the tube will probably be hard, you can kill two birds with one shot here, brazing (or silver-soldering with coarse-grade silver-solder, such as Johnson-Matthey's B6 alloy) the end of the barrel, and softening the metal round the tube holes. After pickling, washing and cleaning, insert a bit of $\frac{1}{4}$-in. round steel rod in each tube hole, and force it down into the position shown by the tubes in the longitudinal section of the boiler.

Cut three pieces of $\frac{1}{4}$-in. by 22-gauge copper tube, each 9 in. long ; well clean the ends, and insert one on each tube hole. Now put the open end of the barrel into the big hole in the backhead assembly, and the ends of the water tubes in the small holes, carefully lining up the whole issue, so that the tubes lie parallel with the centre line of the barrel. The joint between the barrel tube and the backhead plate, and both ends of the water-tubes are then silver-soldered with coarse grade silver-solder or B6 alloy. Stand the assembly in the brazing pan on a layer of coke, with the barrel pointing skyward, put some wet flux (I use either Boron compo or Tenacity No. 1 for jobs like these) around barrel and tubes, and heat up the whole doings with a blowlamp, until hot enough to melt the silver-solder when applied. A $2\frac{1}{2}$-pint lamp is quite man enough for this job ; in fact, a 1-pint lamp will do it, if it is well pumped up, and the party behind it has patience enough to hold it until sufficient "therms" have been applied to the boiler.

After doing the back end, lay the barrel on its back in the coke (no need to pack around it) and blow straight on to the ends of the tubes in the distorted holes until they, and the surrounding metal, are hot enough to melt the

silver-solder. I recommend beginners to use a blowlamp for this job, because, even if they possess an oxy-acetylene outfit, it needs great care in using, to avoid burnt tubes. If I use my "Alda," I put a big tip in it, and adjust the gas pressures for a big diffused flame that burns silently without any hissing at all. An oxy-coal-gas blowpipe is ideal for the job, but Mr. Shinwell might raise objections.



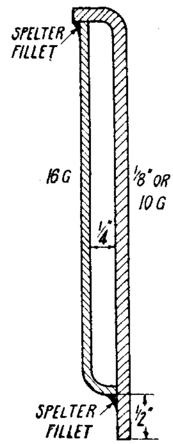
Inner plate for backhead

Pickle, wash off, clean up and file the backhead plate flush with the flange; then try the assembly in the steel casing. Temporarily clamp in position and mark off the location of the dome and safety-valve bushes, through the respective holes in the casing; then remove the inside assembly, drill the holes as described for the loco-type boiler, and fit the bushes, which are also the same as the loco-type. These can easily be silver-soldered in by giving them a dose of "Easyflo" flux (Tenacity No. 3), blowing straight on them with the blowlamp flame—no coke packing required—and applying a little "Easyflo"; failing that, use borax-and-water paste and No. 1 grade or best silver-solder. Pickle and clean up, and Bob's your uncle as far as blowpipe artistry is concerned. Billy Muggins himself ought to be able to make a first-class job of such a simple boiler, with a little pluck, patience and perseverance!

Staying and Assembly

One solitary longitudinal stay is required, and that is exactly the same as described for the solid longitudinal stays of the "Lassie," being a piece of $\frac{3}{16}$-in. copper rod 11½ in. long, screwed $\frac{3}{16}$ in. by 40 at each end, and furnished with a couple of blind nipples made from ⅜-in. hexagon rod, screwed $\frac{5}{16}$ in. by 40, and the whole doings inserted as described for the "Lassie." If you put a smear of plumber's jointing around the threads on the nipples, you won't have any Welsh vegetables growing around them. The hole in the backhead, for the nipple at that end, is drilled and tapped exactly ¼ in. above the centre-line of the outer casing. No stays are needed in the water-space at the bottom of the backhead, as the three tubes silver-soldered into the inner plate will effectually prevent any tendency to bulge it out; whilst the thickness of the backhead itself enables it to stand the pressure without the aid of any additional staying.

To hold the boiler in place in the outer shell, drill a few No. 41 holes around the firebox end of the steel casing, $\frac{3}{16}$ in. from the edge; one



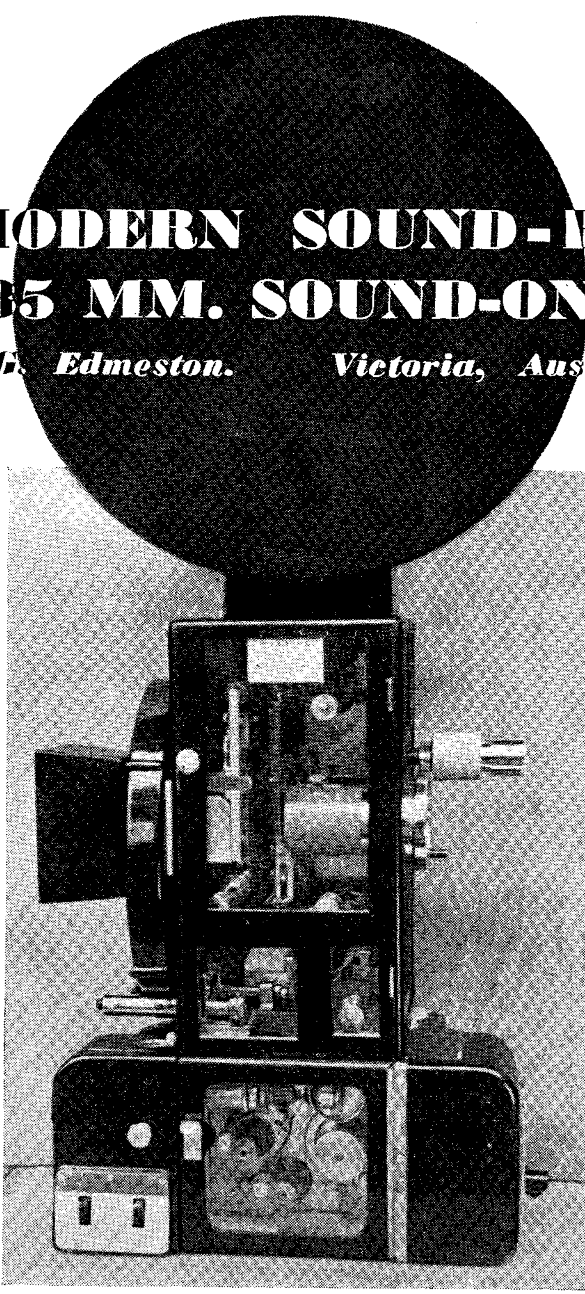
Alternative arrangement of backhead

opposite each end of the "piece of foundation ring" at the bottom, and, say, three more each side at about 1½-in. centres. Put the boiler in the casing, adjusting it so that the backhead is vertical, and projecting about ⅛ in., as shown in the longitudinal section; the dome and safety-valve bushes should line up with their respective holes in the casing, and the inside boiler barrel should lie horizontal, as shown. Run the No. 41 drill through the holes in the casing, with the inside assembly temporarily clamped in place, and make countersinks on the backhead flange; follow up with No. 48, and tap either 3/32 in. or 7 B.A. Use brass round-head screws for fixing, with a smear of plumber's jointing on the threads. It won't matter a bean about these screws piercing the water-space, if brass screws are used, and the threads are O.K. You have to screw the fittings into the water-space, and no water leaks around the threads of those when fitted properly!

The front end of the casing is closed by a casting representing an ordinary smokebox front with door and hinges, which our advertisers will be able to supply. It should have a chucking-piece cast on the front; and all the turning it needs is merely chucking this in the three-jaw and turning the step to a tight push fit in the end of the casing, as shown in the longitudinal section. You can reverse it in the chuck, and grip by the turned edge, then face or part-off the chucking-piece, centre it, drill No. 48 and tap 3/32 in. or 7-B.A. for the stem of a pair of dummy handles, for sake of appearance. As mentioned earlier, anybody who wishes to fit a separate smokebox can do so. The complete cast smokebox which needs no saddle, as specified for "Petrolea," is just right for this engine, and can be used by making the barrel of the casing 2 in. shorter than shown (that is, 7½ in. from end of barrel to throatplate) and fitting the smokebox exactly as I shall describe for the loco-type boiler. A separate smokebox can also be made from a 2⅛-in. length of 3⅜-in. brass tube; this will also be described in connection with the loco-type boiler, also the saddle, which is needed to support it. As the whole of the backhead is a "water area," same as on the loco-type boiler, the arrangement of fittings, regulator, blower, gauges and so on, will be the same, except for the addition of the feed clacks, which will have to go on the backhead instead of on the sides of the barrel.

A MODERN SOUND-HEAD FOR 35 MM. SOUND-ON-FILM

by G. Edmeston. Victoria, Australia



THE recent articles on motion-picture subjects suggested to me that I should break the ice and submit my "new baby." The construction and design of this machine was born after reading a paper by the Society of Motion Picture Engineers on "Film Drives,' which described the mechanics of the rotary stabiliser or fluid flywheel to great lengths, and its use as a means of maintaining constant velocity of film past the scanning beam.

I set to work on drawings (general arrangements, etc.), little realising the amount of work involved, the midnight oil, cigarettes and cups of tea, to be expended for the next two years.

As two sound-heads were required, I resolved from the start to build them progressively, side by side. The main frame patterns were first made, and the castings (C.I.) were taken out for planing and boring for the two spindles.

The main sound-shaft is of tensile steel, and runs in a bronze bearing at the front, and a self-aligning race at the rear, adjacent to the main flywheel. The flywheel is 10 in. diameter, but is not shown mounted in the photographs.

The sound-shaft and hold-back sprocket shaft are coupled by two gears, 2 in. diameter, at rear of the main casting, but behind the rotary stabiliser wheel.

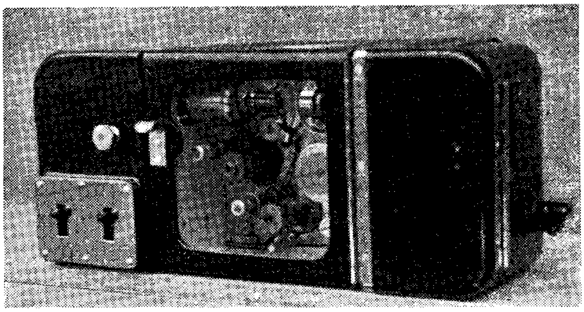
The stabiliser is complete as a unit, and bolts into position on the main casting.

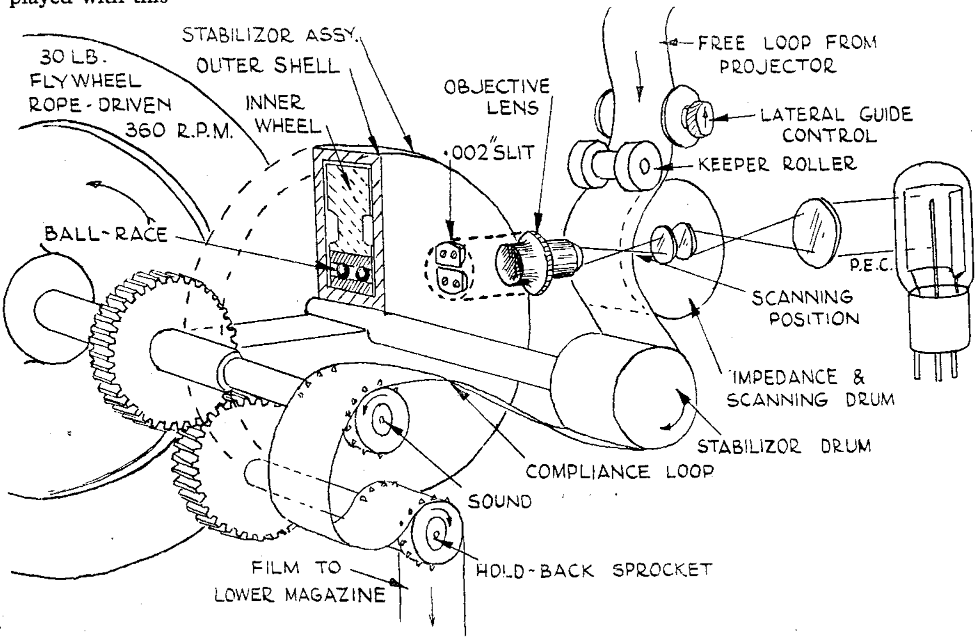
The stabiliser-drum and shaft was turned out of a $1\frac{3}{4}$ in. diameter billet of nickel-chrome steel, so as to be fairly resistant to rusting, and is mounted on two ball-races. The stabiliser wheel consists of a thin oil-tight aluminium shell, rigidly secured to the film drum shaft. Inside the shell is mounted the inner flywheel, on a rigid double-row ball-race. The clearance between the two wheels was originally machined to a clearance of 0.002 in., which called for some very careful work. This was too much of a good thing, and the clearance was increased to 0.007 in., as the thinnest oil locked the wheel and shell almost solid. The design requirements were that the inner wheel must have a minimum of three

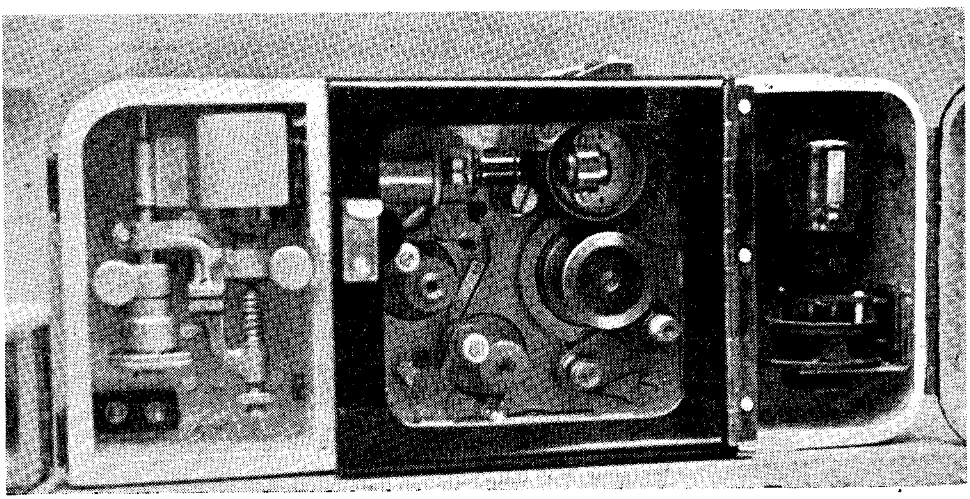
times the kinetic energy of the shell. Using brass for the inner wheel, and a maximum outside diameter of $5\frac{1}{2}$ in., this was only just managed under the present design of a cast shell. The wheels wer: balanced, and filled with oil, S.A.E. 10.

I must confess I played with this device when finished for nearly a whole evening, and found it most interesting to observe its efforts to avoid change in velocity.

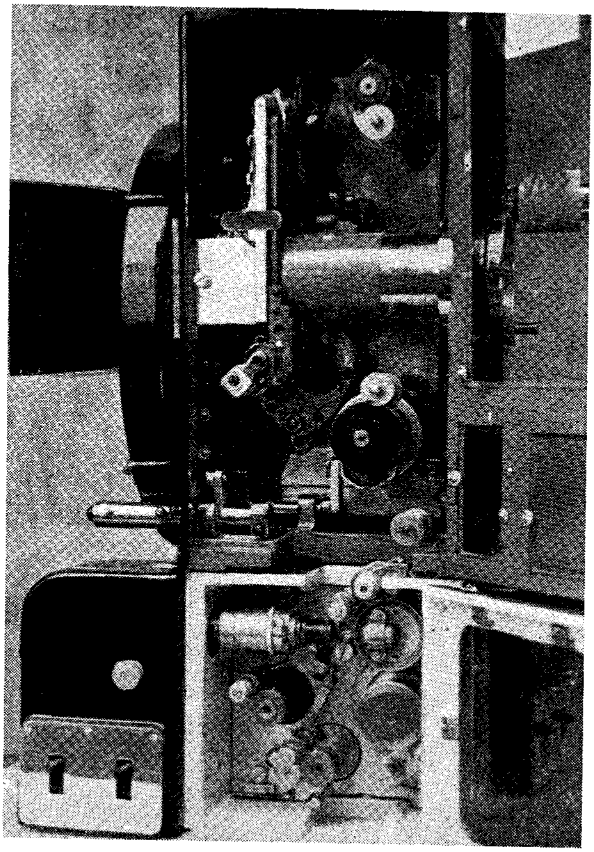
Briefly, the principle of the stabiliser is as follows: The sound sprocket pulls the film around the stabiliser drum, which rotates the







outer aluminium shell. The oil coupling between the two wheels then slowly pulls the heavy inner wheel, till it reaches sound speed. The friction of the unit being very light, the film coasts around with the inertia of the stabiliser, and the compliance of the film maintains a loop between drum and sprocket, effectively isolating disturbances from the drive (mostly 96 cycle). The loop is maintained with the drum running in step with the sound sprocket, yet without any mechanical drive to the drum. "Hunting" between the sound sprocket flywheel and the stabiliser is controlled by the inner flywheel giving and taking energy through the oil, to and from the shell.



A felt-mounted roller holds the film in contact with the stabiliser drum by spring pressure. The upper or scanning drum is mounted on ball-races, and carries the doublet lens in the centre. The photo-cell is mounted on rubber cushions, to prevent any vibration causing noise in the sound-head and is housed in its own compartment at the front.

All parts are chromium plated (dull) with interior of the casting cream and exterior black (Dulux hand-sprayed). The projector-head shown with the sound-head is a "C.&W. Senior"; the rear shutter is Australian-made and similar in some respects to the famous "Simplex." Ball-races were used whenever possible, as the unit was designed to avoid static friction; races and rollers only contacting the film. The switches on the excitor lamp compartment door are the motor ($\frac{1}{4}$ h.p.) and excitor lamp (10 v. 8 a.). The drive to the projector is by 8-mm. chain from the main sound shaft. All the shafts were turned from nickel chrome steel, and finished with laps to fit races and sprockets. Other parts, such as screws, pad rollers, etc., were case-hardened for twenty minutes.

The scanning system is the direct type, with a slit in the lens tube, adjusted to throw a beam on the track 0.0015 in. $\times$ 0.085 in., and was made with gunmetal castings. The objective is a "Bausch and Lomb" 10x. The condensers and doublet lenses were ground for me by an optician. The gears and main flywheel were the only other jobs done outside my own workshop.

Lateral guide control of the film is by vernier control at the top of the upper drum.

STEAM LAUNCH "VENUS"

(*Continued from page* 684)

"capped" with $\frac{1}{16}$ in. dia. wire. *Burners*: fashioned from three $\frac{3}{8}$ in. dia. cartridge cases. These are attached to an inlet pipe of $\frac{1}{4}$ in. dia. brass, and rest in a tray of sheet brass. *Meth. Container*: Built up from sheet brass, an old oil bottle "end" being used for a "filler."

Various Components

Propeller Shaft: $\frac{1}{8}$ in. diameter steel rod. *Propeller Boss*: from an old solid brass bullet. *Propeller Blades*: (3) from sheet brass. *Bollards*: from brass wood screws. *Fairleads*: from $\frac{3}{8}$ in. square brass. *Rudder Tube*: $\frac{3}{16}$ in. diameter brass tube. *Rudder*: Sheet brass. *Tiller*: Brass rod. *Quadrant*: from sheet brass, and notched at about 2 deg. intervals. *Masts and Yard*: from white pine dowels. *Mast Truck*: End of knitting needle. *Rigging*: No. 3 fishing line. *Eyes* and *Blocks*: from wire and sliced knitting needles. *Ventilators*: $\frac{3}{8}$ in. Brass tubing, and sheet brass. *Mast Head Lamp*: Filed from a piece of solid $\frac{1}{2}$ in. square brass, fitted with "Perspex" glass.

General Dimensions

Boat: Overall length, 26 inches; beam, $6\frac{1}{2}$ inches; height, keel to main deck, $3\frac{1}{2}$ inches, keel to cabin top, $5\frac{1}{2}$ inches. *Power Unit*: Total length 11 inches; height to top of funnel, $5\frac{3}{4}$ inches; width, 3 inches; weight, 4 lb. loaded.

*A Tandem Compound Engine

by "Crank Head"

THE main feed pump, which is a separate engine, is, as far as the water-end is concerned, a copy of the Weir pump. But there are two exceptions, one being the design of the valves, and the other the arrangements for the feed discharge, and these differences will be referred to later on.

The pump cylinder was turned from a piece of round brass as shown in Fig. 41, A. The outside was turned to finished dimensions and the bore was left under size and only rough-turned. The overall length of the cylinder must be the length of the stroke of pump, plus the water-way at the bottom of the liner, plus the length between the internal collar D and the outer face of cylinder. These remarks are a generalisation; the actual lengths would have to be taken from a scale drawing of the pump.

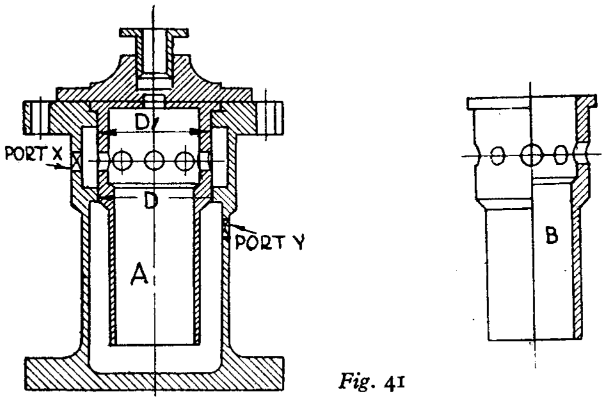


Fig. 41

The valve chambers should next be made; in the writer's case, the inlet and outlet flanges were made separately and screwed to the body of the valve-box, which latter must be made from the solid. The chambers, two in number, must be finished externally and rough bored inside. The next operation is the marking-off and cutting of the ports, one in each box; they must be situated in a position midway between the top of the suction valve-seat, and the underside of the delivery valve-seat; reference to B, Fig. 42, will explain what is meant. The ports in the pump cylinder are situated 45 deg. on each side of the centre line of the pump. A, Fig. 42, illustrates this. One port must be cut in a position as at X, Fig. 41; that is, in the space between internal collars D and D1; the second port must be below D, Fig. 41.

Having cut the ports in both valve-boxes, and cylinder, attention must then be turned to the connecting pieces, X and Y. In the case of X, Fig. 44, it is just a rectangular piece of brass made to fit one end in the port X, Fig. 41, and the other end in a port of the same size in one of the valve-boxes. The passage through the connecting-piece was drilled and filed out to a rectangular section, as X, Fig. 44. This connecting-piece was made a light driving fit in both valve-box and pump-cylinder, and, when assembled, the valve-box should occupy a position as at L, Fig. 42.

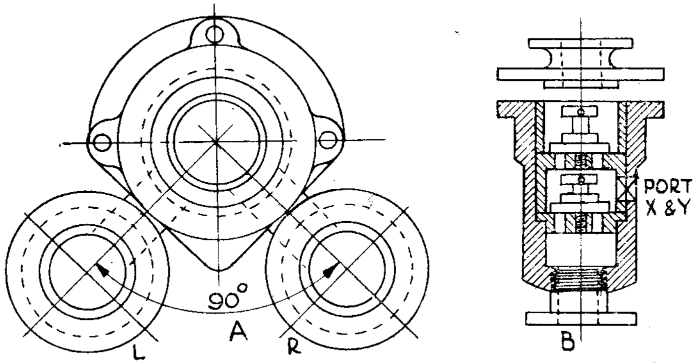


Fig. 42

The other connection is rather more complicated and is shaped as at Y, Fig. 43; the passage for the water is shaped as shown in the three views at Y, the most important dimension being the length of the passage, which must be such that, when the bottom of the passage is level with the lower edge of the port in the side of pump-cylinder at Y, Fig. 41, and the top edge of the horizontal portion of the passage is in line with the top edge of the port in the valve-box, the outlet flanges of both valve-boxes must be in alignment with each other. The edges of this second connection must now be turned or filed to conform with the radius of the cylinder, and the other to fit the outside of the valve-box.

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* *Continued from page* 671 "*M.E.*," *May* 29, 1947

The enlarged part of the cylinder and valve-box in the wake of the connecting-piece was cut away, thus allowing the latter to fit snugly on cylinder and valve-box. When the second valve-box is placed in position on the pump-cylinder, it should occupy a position as at R, Fig. 42.

The next operation can make or mar the whole job; for that reason, it pays to spend a little time and effort in securing the valve-boxes

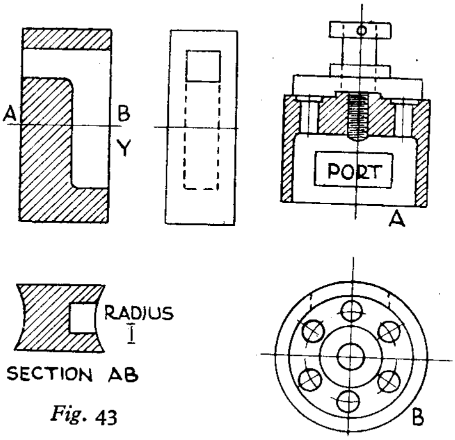

Fig. 43

and connecting-pieces in their respective positions on the cylinder. Without going into details as to how they should be secured, it is sufficient to remark that, as the whole lot has to be heated and silver-soldered together at one operation, too much care cannot be exercised. If care is taken, a good job can be made of it. One thing is absolutely essential, and that is a flame blowlamp, or any other which is well up to its job; insufficient heat is fatal.

The final machining operations can then be tackled. The first of these is to bore the cylinder. The writer did all the boring operations with the pump body, as it has now become, mounted on the faceplate; this method insured that all bores were parallel, also the faces for covers. This is essential if the job is going to look anything when completed. The large portions of the cylinder were first bored, allowing $\frac{1}{8}$-in. all around the liner below position D, Fig. 41,A. This dimension is not critical, as long as the cylinder is left thick enough for strength. The lower collar, D, is then bored, and, D1, bored 0.008-in. larger; the recess to house the collar on the liner is then bored to finished dimensions; a cut taken across the top flange of cylinder completes this part of the job.

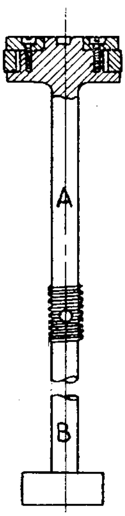

Fig. 45

The pump-body is then re-set on the faceplate with one of the valve-boxes in position for boring; in the case under discussion, there were three diameters in each bore, the first being the screwed bore to take the suction pipe, the second to fit the spigot which will be machined on the under side of suction valve-seating, and the third to take the delivery valve-seat and locking-ring, this is illustrated at B, Fig. 42. The bore for valve-seatings must be carried far enough down into the valve-box to ensure that the port comes clear of the suction valve-seating; as in the case of the cylinder, a cut across the flange for valve-cover completes the valve-box.

The whole assembly was then set-up in the lathe for machining the second valve-box; this is simply a repetition of the former operation and needs no comment. Att his stage, it was thought as well to subject the pump to a hydraulic test, which was to 200 lb. per sq. in. and was satisfactory. Should any pinholes reveal themselves during the test, a touch of good hard tinman's solder is the remedy; any attempt at making good with silver-solder would lead to trouble, particularly as all machining has been completed.

The pump liner is the next job to be taken in hand, and is a straightforward turning job; B, Fig. 41, is self explanatory. The bore should not yet be made to finished dimensions, as it will be necessary to run a light cut through it after it has been pressed into the cylinder. The enlarged portion of the outside of the liner should be turned a good force-fit in the cylinder, not forgetting that 0.008-in. increase in the diametet of D1 as compared with diameter at D. This 0.008-in. may not really be necessary, but it was thought that, if D and D1 were both the same diameter, pushing the thin liner through both collars might make the diameter at D small; a leak at this position would upset the working of the pump, so this little extra trouble was taken.

The collar at the top end of liner should then be turned to size to fit the recess already turned in flange of cylinder, and the holes around the

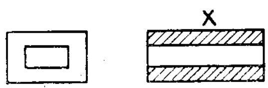

Fig. 44

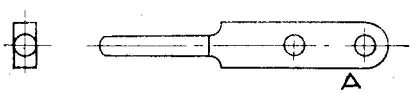

Fig. 46

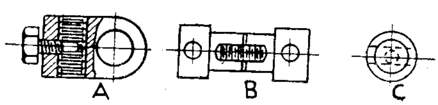

Fig. 47

top of the liner marked-off and drilled. In the present case, there were six holes each $\frac{3}{16}$ in. diameter. The liner can now be pressed into place, when it should occupy a position as at

A, Fig. 41. Once again, the pump was mounted on the face-plate, and the liner bored to finished dimensions, and the top portion bored slightly larger, as per sketch. The working part of the pump liner is that portion from D to the bottom.

The cover for the pump-cylinder was now made as shown in Fig. 41, A, not forgetting a small spigot on the under-side to be a good fit in the liner. In the prototype, the valves are winged and fitted in groups in the suction and delivery-valve chests; chiefly on account of their small size and the lack of room, it was decided not to attempt making them in this way, and after considering ball-valves, one large winged valve, and rubber valves, it was decided to make the valves on the Kinghorne principle, excepting that each valve was one disc instead of the multiple discs used with Kinghorne valves as fitted in air pumps. It is open to question whether the valves as fitted would be successful in large pumps working against high pressures; if such valves were made heavy enough to withstand the tendency to buckle under pressure, they would be so heavy that the wear would be excessive if not prohibitive. Such troubles are not anticipated in a pump as small as the one being described.

To deal with the suction valves, the seating was turned a really good fit in the bore of the valve-boxes, and also a good fit on their seatings. Six holes were drilled through each seating as shown in B, Fig. 43, and a centre hole tapped to take the spindle on which the valve would work. A narrow parting-tool was then used to turn the face of the valve-seating in the wake of these holes, a few thousandths below the surface of the valve-seating; see A, Fig. 43, and this procedure was followed in all cases.

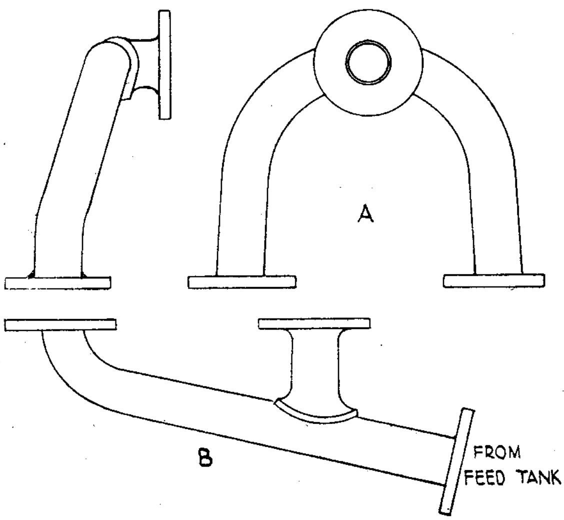

Fig. 50

The valves were next turned up, the centre hole bored a good sliding-fit on the valve spindles, and a light recess turned around the hole. The valve thus takes its bearing on the metal around the ring of holes both inside and outside of the holes. Each valve was now carefully ground with the spindle in position on its seating, using, first, very fine carborundum grinding paste, then finishing with a lapping compound, and when finished as far as could be seen, each valve had a perfect bearing on its seat. A, Fig. 43, illustrates what is meant. The only difference between the suction and delivery valves was in the shape of the seating. In the case of the suction valves, the seating was just a disc, but the suction-valve

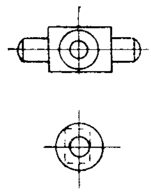

Fig. 48

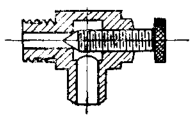

Fig. 51

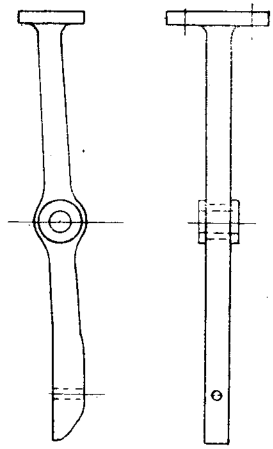

Fig. 49

seatings are in the form of cylinders with one closed end; in this end, the holes for the passage of the water were drilled, and the valve made and fitted as in the case of the suction valves.

The depth of the cylinders was such that a port to correspond with that in the valve-box could be cut in the wall, as illustrated at A, Fig. 43, and B, Fig. 42. The external diameter of these cylinders was also a good push-fit in the bore of the valve-boxes, and their lower edges fitted properly on the face of the suction-valve seatings. The valves were then assembled and pushed into their respective boxes, suction valve first, and then the delivery valves, great care being taken to see that the ports registered when the valves were in place. A plain sleeve was then turned, also a good push-fit, in each of the valve-boxes, and its length is such that it stands about 0.002 in. above the top of the valve-box when it is pushed down into position. When the cover is in position and screwed down, the pressure on the sleeve locks the valve seatings in position.

At this point it may be as well to refer to the second detail in which this pump differs from the Weir, viz. the discharge of the water. In the Weir pump, there is incorporated in the valve-chambers a cross connection which allows the water to be discharged from one side of the pump. In the pump being described, no simple method of accomplishing this could be seen, so a pipe shaped as at A, Fig. 50, was made, in which each leg is connected to one valve-box, and the water discharged through a central outlet. The piston and rod for the pump are made in one

piece, as at B, Fig. 45; the piston is a good fit in the liner and no rings are fitted, and is purely an experiment which it is hoped will prove successful. Incidentally, the pump-rod and piston are of bronze. The suction-pipe is illustrated at B, Fig. 50, all joints are silver-soldered, as also is the discharge-pipe. The bore of the pump is $\frac{9}{16}$ in. and the stroke $\frac{7}{8}$ in.

The bore of the steam cylinder is $\frac{7}{8}$ in. and stroke $\frac{7}{8}$ in. The piston and rod are made in one piece of steel, and the piston is fitted with one Ramsbottom ring held in position by a junk-ring. The junk-ring is secured to the piston by four cheese-headed 4-B.A. steel screws, the heads of which fit in counterbores in the ring and are flush with the top of the piston. Fig. 45, A, illustrates the construction of piston. It will be noticed that the centre portion of the top of piston has a slot cut across it; this is to enable the piston-rod to be screwed into the crosshead, A, Fig. 47. Reference to Fig. 45 will shew a hole drilled through the rod at the junction of the piston and pump-rods; this is to accommodate the point of the set-screw in the crosshead, and as the hole is half in each rod, when the rods are screwed into their position in the crosshead, and the set-screw is screwed home, the rods cannot possibly unscrew from the crosshead.

The piston-valve is actuated by the movement of the piston-rod through the bridle-gear, one link of which is shown in side and end elevation at Fig. 46. The round end of the links passes through and is a good sliding fit in the holes in the gudgeon-pin, B, Fig. 47. It will be seen from the sketch that the gudgeon-pin is made in two halves, joined together by a $\frac{1}{8}$-in. steel stud which is screwed half into each portion of the gudgeon. In actual practice, the gudgeon-pin is a cylindrical pin which passes right through the crosshead and is the same diameter throughout. Had that been so in the model, there would have been very little metal left in the working ends of the pin after the holes had been drilled, and this could only have been obviated by increasing the size of the crosshead, which would have made a clumsy job.

Fig. 46, B and C, show two views of the gudgeon-pin, and, apart from stating that the reduced portion in the centre of B is a working fit in the bore of the crosshead, and that the distance between the inside faces of the enlarged portions is equal to the thickness of the crosshead, the sketches will explain. The links and crosshead are of steel, and the gudgeon-pin is brass. Fig. 48 is a plan and end-elevation of the crosshead through which the slide-valve spindle passes, and is held between the ends of the links; the reduced portions of the crosshead are a working fit in the holes A, Fig. 46.

Fig. 49 is the column secured at the top end to the under-side of the steam cylinder, and at its lower end to the pump cylinder; the hole in the centre of column is to accommodate the fulcrum-pin on which the links swing, and is bushed.

Fig. 51 is a part section of the cylinder drain-cocks, and is just an ordinary needle-valve, which needs no description.

(To be continued)

Concrete Facts

(Continued from page 686)

There is a great difference; the former takes its initial set very quickly as well as hardening quickly afterwards; the latter sets at about the same speed as ordinary Portland cement, but hardens much more quickly afterwards, attains its strength quicker, and can have the shuttering removed much earlier than with Portland cement, it is also stronger finally.

Draining

In an article in THE MODEL ENGINEER (February 1st and 8th, 1945) on ground level railway tracks, some excellent advice was given but in my opinion the writer omitted certain points. For example, soak-aways to the side drains (or French drains, as we call them) are quite ineffective unless the soil in which they are dug is reasonably pervious to water, or unless they are dug deeply enough so as to reach a pervious stratum. Such soak-aways dug, for instance, in London clay, would be of little use, and in a case like that it would be better to run a drain away from the track to a lower point from which the water could get away easily.

There has been mentioned for use as railway track ballast, pea-gravel; this material may vary in different parts of the country, but the stuff that I know as pea-gravel or pea-grit is a small rounded stone of about $\frac{1}{8}$ in. to $\frac{3}{16}$ in. diameter. Now for use as ballast under a railway track we want an angular stone, such as crushed gravel or crushed rock. Examine a full-size railway track and note the ballast; see how different it is to walk on as compared with the shingle (which is rounded) on the sea-shore, and you will appreciate my point; the shingle allows your foot to sink in and tends to spew up all round your foot; the angular stone ballast takes the load without shifting to any extent, and in turn transmits the load to a larger area of the soil beneath.

Warning

There is another point on which I notice that amateurs (and professionals sometimes, as well) make a mistake, and that is in the use of timber in conjunction with concrete. As a general rule timber should never be buried in concrete since the air cannot get to it, and it will rot away; this is particularly noticeable at the point where the timber enters the concrete, for instance, an upright timber post set in a concrete base, as used, perhaps, in a passenger-carrying miniature railway, will probably break off in quite a short time; this is true, even if the timber is creosoted. Wherever you use timber, place it so that the air can get at it. There are, of course, some timbers which are very durable, particularly when completely buried in the ground or are completely under water, but they are not normally the timbers which are purchased at the ordinary timber yard.

THE PLYMOUTH SOCIETY GETS GOING

by R. W. Dunn

ON Monday, April 21st, the doors were opened at Messrs. Bartons (Morris) Motor Showrooms for the first Exhibition to be staged by the Plymouth Society of Model and Experimental Engineers. Opened by the Rt. Hon. The Earl of Mount Edgcombe, who was supported by The Lord Mayor of Plymouth, success was assured from the opening day, for during the brief 12 days that the show was on view to the public, no fewer than 11,000 people paid for admission.

Much credit is due to the organising Secretary, Mr. J. W. Moyse, and his helpers for the hard work and enterprise put into this inaugural show, especially when it is stated that such an outstanding number as 385 Exhibits, was made possible on this, its first show. The Directorate of Messrs. Barton's Motor Company, contributed in a very high degree to the success of the show also, in allowing their sumptuous and well lighted Showroom, which is situated in the best part of the town, to be used for this event, and their kindness will not be forgotten by any of the Members of the Society.

The photograph reproduced, taken by Plymouth Industrial Photos, shows the general view of the Engineering Models, which is only a portion of the area taken by the Exhibition, and does not include the Boat and Aircraft Section, the items of which comprised some 170 exhibits. On the Engineering side there were 41 Locomotives (one $10\frac{1}{4}$ in. gauge), 39 Stationary Engines and Traction Engines, some of which were working the whole of the show on compressed air, supplied from Messrs. Barton's Air Service Mains. There were also a good show of tools and appliances, electric clocks, etc., making a grand total of 385 exhibits.

Evidently the Plymouth Society has nothing to fear from any of its rival Societies efforts as far as exhibition is concerned, for the writer, in talking to several enthusiasts, gained the information that the Plymouth Show was well ahead of anything seen at other large provincial centres. That all this has been achieved in such a short time since the Society's inauguration only last Autumn, speaks volumes for the energy and ability of the Hon. Secretary, and Standing Committee of this now prosperous Society. Anyone wishing to join should write to :—Mr. J. W. Moyse, 3, Evelyn Place, North Hill, Plymouth.

Photo by courtesy] [*Plymouth Industrial Photos*

Some of the models on show at Plymouth